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DIAMONDS.

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QUOTING the words of Pliny we can say: "*Maximum in rebus humanis, non solum inter gemmas, pretium habet adamas.*"¹

As far as our reliable records reach back into the dim and mystic ages, we find the diamond occupying a prominent position in the estimation of man. Above all other of its qualities, which at present determine its value, the superior hardness to all substances then known, seems to have impressed the Ancients. There appears to be but little doubt, that at very early ages the East Indians and the original inhabitants of the Chinese Empire knew the value of diamonds over all other gems. It is supposable, too, that the art of cutting was known to them, although it was not employed in the western countries until many centuries later.

Some doubt may appear whether the ancient Hebrews really possessed the diamond. In translations the word "shâmir" is rendered as diamond. We find that the breast-plate of the High Priest contained a "diamond" in the second row of precious stones. We furthermore find, however, that these twelve stones "were according to the names of the children of Israel," . . . "like the engravings of a signet, every one with his name, according to the twelve tribes." It seems improbable that they should have been able to engrave the diamond. Other passages occur where the diamond is used as a symbol of greatest hardness. One allusion is made that shows its application in the art of engraving; Jeremiah says: "The sin of Judah is written with a pen of iron and with the point of a diamond; it is graven upon the table of their heart." *Corundum* was known to the Hebrews, and

¹Among all human things, not only among gems, the diamond is the most precious.

the comparative paucity of direct references to the diamond may lead to the supposition that some one of the corundum minerals was thereby meant. If a diamond was really spoken of, then this is one of the oldest reliable mentions made (600 B. C.).

Among the Greeks, Homer (1000 B. C.) uses the word "*Adámas*," but in his writings it signifies steel. There is no evidence that the precious stone known 600 years later, under the name of *adamas*, was among those with which Homer was acquainted.

Hesiodus, living about an hundred years later than Homer, uses the same word, but it merely designates some—to his mind—indestructible metal. Thus the sickle of Chronos, the helmet of Heracles, the chains binding Prometheus, and other similar instruments were composed of *adamas*. Roman poets and other writers have copied the idea and have constructed the gates to Hades and other durable objects from the same material. An interesting analogy, although a purely poetical one, may be found in the fact that the first seal rings, *Sphragides* of the Greeks, were manufactured from the chains confining Prometheus. The stones set into them were obtained from the rock to which the unfortunate thief was bound. Thus did man honor him who conferred a lasting boon by stealing fire from the irate Jupiter.

Later on, the term *adamas* was applied to the diamond. There is evidence extant showing that the cutting qualities of diamonds were utilized in Greece and Asia Minor about 400 years before Christ. Owing to the fact that no mineral or metal could produce any graven impression upon the diamond, it took the name above given, which literally means "not conquerable." Pliny adopted it, as did others of the more recent Roman writers. The former furnishes a learned description of the gem and its peculiar qualities, while the latter use the word to express a very high degree of hardness.

Pliny (born A. D. 23), states that six species of *adamas* are known. Of these five are probably only minute flakes of gold contained in some other mineral. The last one, however, he mentions as not occurring with gold, but found in India, in the form of crystals. From his description of the crystalline forms, the specimens he had under consideration might as well have been quartz as diamond. As he was acquainted with rock-crystal, however, and describes it elsewhere, we may conclude that he meant the

diamond. Pliny had a very thorough appreciation of its hardness, and repeats the fable then current, with reference thereto. He states that an adamas laid upon a new anvil, and struck with a new hammer, will shiver both, while the gem remains intact. Only by sprinkling it with the fresh blood of a male goat, can the excessive hardness be conquered. When the adamas is thus broken, however, it is shattered into innumerable small fragments so minute, indeed, that they can scarcely be seen with the naked eye. Bishop Albertus Magnus, of Southern Germany, in 1260, repeats the same statement, and sententiously adds, that the blood of the animal became far more efficacious, if he had imbibed sour wine and eaten some parsley just before being killed.

Owing to the rarity of the mineral this fable could be perpetuated for more than 1400 years, in countries far removed from those where the diamond was originally found.

After expressing his surprise that so disagreeable an animal as the goat should have so great a power over this most precious stone, Pliny states, that small splinters of diamond are set in iron holders, and used for the purposes of engraving and drilling. This shows a remarkable coincidence with the utterances of Jeremiah more than 600 years earlier.

At the time of Charles the Great (768 to 814) diamonds were highly prized as ornaments, and ever since that time they have steadily advanced in demand until the present day. During the reign of Louis XIV, in France, diamonds were much sought after, and some were brought to light that are famous for their beauty even now. Having at that time made an enormous stride in the favor of all people admiring mineral ornaments, diamonds have since then maintained their position. To-day they are a staple article in the market, and although new discoveries may somewhat affect their value, the demand is sufficiently great and constant to render them one of the most valuable among the precious stones.

Of all the countries which have furnished diamonds, India has been known as a prolific source for the longest period of time. Perhaps the most famous of all diamond fields there are the Golconda Mines. Thousands of people have found and many still do find employment there, although much of the wealth has already been exhausted. During the reign of Louis XIV, Tavernier visited the Orient to collect diamonds and precious stones for his

king. At that time (about 1680) he found 60,000 persons engaged in searching for diamonds in the mines of Ellore, in India. Next to India in importance is South America. The mines in Brazil were opened in 1727, and the best of them are situated north of the Rio Janeiro. On the Rio Jequitinhonha and Rio Pardo the most remunerative fields are found. Other placiers have yielded very good diamonds, however.

On Borneo, in the Ural Mountains, and in Australia, diamonds have been found. In the United States they have been collected at several localities, but only in comparatively isolated specimens. Diamonds have been obtained from North Carolina, Georgia, Virginia and California. The notorious occurrence of these precious stones in what was termed the "Arizona diamond fields," situated in North-western Colorado, is probably still too fresh in the memory of everybody to require special mention. Diamonds were certainly found there, but, to use a popular phrase, "they had not grown there."

Recently discoveries of extensive diamond fields have been made in Africa. They are situated on and near the Orange and Vaal Rivers, and are being worked with energy. Although their discovery dates back but a comparatively short time, it appears that the existence of diamonds there was already known during the last century. According to Dr. J. W. Morton, the natives have for a long time used diamonds from this locality to drill their stones, and formerly made periodical visits to replenish their supply of material.

As is frequently the case, the present impetus in that region to mining operations was given by the accidental discovery of a diamond. It was found in the hands of some children who were playing with the pretty pebble.

Wherever diamonds are found, they occur in redeposited material. River-drift or boulder-clay may contain them. No matrix for them has been recognized with certainty as yet, although it is claimed that the Itacolumite (flexible sandstone) of Brazil contains them. This assertion is scarcely proved, however, and even if it were so, this very Itacolumite is but the product of re-deposition. It may be regarded as a significant fact, perhaps, that the localities of North Carolina and Georgia, where diamonds have been found, are not far removed from occurrences of flexible sandstone. In the South African diamond fields the gems are con-

tained in a conglomeritic mass. It is composed mainly of volcanic material, but has evidently been deposited by water. In its general, physical character it may be compared to the "blue cement" of California, which is auriferous.

Of all these localities mentioned, India has produced by far the greatest number of celebrated diamonds. The largest diamond of which we have any knowledge, is mentioned by Tavernier. It was found in 1550, was in the possession of the Great Mogul at the time of Taverniers visit, and weighed 900 carats (1 Parisian carat = 205.5^{mgr.}). The present "Great Mogul" weighs 279 carats, and may be a portion of the original one.

Ko-hi-noor.—Tavernier gives the weight of the original Ko-hi-noor ("mountain of light") as being 787½ carats, but other reports place it a little higher. Weighing 186½ carats it came into the possession of the British crown, but was considerably reduced by cutting. Lately it has been recut, from rosette form to that of a brilliant, and now weighs only 106 carats.

Orloff.—The Orloff, weighing 194¾ carats, is in the possession of the Russian crown. It was purchased by Katharine II, for 450,000 silver roubles and 4000 roubles annuity. This diamond is cut in rosette-form.

The Persian.—In 1832 a diamond was found in the hut of a Persian peasant, by a traveler. It was there utilized for the purpose of striking fire. He purchased the stone and sold it at a high price. The weight of the "Persian" is 130 carats.

In connection with these three diamonds a very interesting observation was made by Mr. Tennant. The Ko-hi-noor, in its first cut, showed two natural planes of cleavage, the Orloff still shows one, and the Persian one. By reproducing as nearly as possible the original shapes of these diamonds, it was found that they probably are three fragments of one very large one. The aggregate weight would be 510¼ carats. It is quite possible, therefore, that these three formed the original Ko-hi-noor, the pride of Eastern nations. Tavernier mentions the fact that it had been cut down from its original size, which might account for the difference in weight. Few, if any gems have so prominent a position in legendary history as the original Ko-hi-noor. More than 5000 years ago the East Indian hero Kama, is said to have worn it in the "great war" (Maha Bharata). The discovery of the Persian led to the above results, as it was, to a certain extent, the incentive to the comparison.

Regent.—By far the most beautiful diamond of the French treasury is the "Regent" or "Pitt." From its original weight of 410 carats it has been cut down to $136\frac{1}{4}$. Its absolute purity and the elegance of its cutting (brilliant) for a long time placed it highest in rank among all the known diamonds. Its earliest history is somewhat obscure. According to tradition a slave found it in 1702 in Golconda. In order to hide it from the eyes of his employers he wounded himself in the thigh and placed the huge diamond within the wound. Having confided the secret of his treasure to a sailor, he accompanied him to sea. The sailor, however, stole the diamond and threw the slave overboard. In England the sailor sold it for 1000 pounds, lived merrily until his money was all gone, and then hung himself. Louis XV. of France bought it for two and a half millions of francs (\$500,000). During the French Revolution, September 17, 1792, the crown diamonds were stolen, the Regent among them. Through the agency of an anonymous letter they were again discovered, hidden in a ditch in the Champs Elysées. Although the Regent and many others were thus recovered, some of the most valuable stones could not then be found, among them the Sancy. After that the French Republic placed it in pawn with a merchant in Berlin. Napoleon Bonaparte recovered it again and had it set into the hilt of his favorite sword. Since that time it has remained in possession of the French government.

Sancy.—The Sancy first appears as the property of Charles of Burgundy. He lost the diamond in the battle of Nancy, 1477. Soon after this it came into the possession of Count Nicolas de Sancy. During 1589, Count de Sancy was in Switzerland, at a time when Henry III of France required securities for some loans he was then making. His loyal vassal immediately dispatched a trusted servant with the Sancy diamond as an offering to his king. Nothing was heard of the servant for a long time. Investigations showed that he had been waylaid and murdered. As his last resource, however, to save the property of his master he had swallowed the diamond, which was found after his body had been recovered. Later it formed part of the crown-jewels and was stolen, together with the Regent in 1792. After having been lost to observation for a long time the Sancy again reappeared in the family of the Napoleons, who sold it to the Emperor of Russia for a half million francs, in 1830. This diamond weighs $53\frac{3}{4}$ carats and is cut in rosette shape.

Among the most prominent diamonds of earlier times are several that are noted for their color.

Florentine Diamond.—This stone is of a lemon-yellow color and weighs 133 $\frac{3}{5}$ carats. It was at one time the property of Charles of Burgundy, who wore it in his helmet. In the battle of Granson, on Neufchatel Lake, he lost it. A Swiss soldier picked it up and sold it to a priest. Pope Julius II. finally obtained it for 20,000 ducats, and eventually it was acquired by the Austrian crown, where it is to-day.

Dresden Diamond.—A very handsome green diamond is owned by the Saxon crown, and is preserved in the Green Vaults at Dresden. The color is a bright green with a bluish tinge; its weight 31 $\frac{1}{4}$ carats.

Hope Diamond.—Banker Hope, of Amsterdam, possesses a fine blue diamond of 4 $\frac{1}{2}$ carats. It is cut in brilliant form, and closely resembles a deep blue sapphire in color. Formerly a blue diamond of 67 carats was among the crown-jewels of France, but it disappeared during the revolution.

Within recent years the two largest diamonds have been found in Brazil and Africa respectively.

Star of the South.—This diamond was found in Brazil in 1853, by a negress. Its original weight was 247 $\frac{1}{2}$ carats, but by cutting it was reduced to 125 carats. The "Star of the South" has a slight pink tinge.

Star of South Africa.—About ten years ago this diamond was purchased from a native, and sold at once for 56,000 dollars.

Cutting.—It is evident that a large proportion of the value of a diamond depends upon the preparation it undergoes, in order to develop its beauty. No evidence is on hand to show that any of the ancient nations, East Indians and Chinese excepted, were acquainted with the art of diamond-cutting. From its very superior hardness, it is natural that it can be cut by no other material. In 1373 there was an association of "diamond-polishers" at Nuremberg, in Germany, but not until 1456 was cutting and polishing carried on as an art. Louis van Berquen, in Holland, at that time proceeded to rub two diamonds together, and finally produced a gray surface. The French word equivalent to our "cutting" is "*égriser*"—to make gray—based upon the first experiments. For a long time Holland had the entire monopoly of cutting diamonds, but finally other nations entered

into competition. In 1660, during the reign of Louis XIII, Cardinal Mazarin had the first diamonds cut for the French crown. Within late years the machinery for cutting diamonds has been greatly improved, so that the Ko-hi-noor was re-cut in the space of thirty-eight days, while the cutting of the Regent had required two years.

Two styles of cutting are employed in shaping the diamond, the *rosette* and the *brilliant*. The foundation for the former is the number two multiplied by three, for the latter the number four. A complete rosette cut will cover the entire diamond with faces of equal, triangular shape, while the brilliant presents a flat surface, surrounded by facets and a deep pyramidal or conical body. Numerous combinations of faces are added to increase the action of refraction. As will readily be seen from the most usual forms of crystallization of smaller diamonds, the brilliant cut can be executed with the least loss of material. It certainly presents the stone to best advantage.

Turning aside from the historical associations of the diamond, we have yet to consider its chemical and physical properties.

Among all minerals the diamond is by far the hardest. Next to it are the various corundum species, ruby, sapphire and others. This alone, to a mineralogist, is sufficient to distinguish it. Its specific gravity is 3.5295, about the same as topaz. The index of refraction is 2.439. Expressing the power of refraction in a more tangible manner, we may say that if we have a glass lens of certain dimensions which magnifies five diameters, an equal lens of diamond would magnify eight diameters. Upon being rubbed the diamond exhibits vitreous electricity. By passing an electric spark *over* a diamond, the stone may be rendered phosphorescent, and retains this quality for a short time. This fact, probably, has given rise to the popular supposition that all diamonds must "shine" in the dark. When looking at a cut diamond it is a good plan to have a dark back-ground, as the brilliancy of the flash thereby becomes more prominent.

Diamond crystallizes in the isometric system, and shows numerous combinations. Most frequently occurring is the octahedron with many combinations. Dodecahedra are found simple and in combination. Perhaps no other mineral exhibits so many different forms belonging to the isometric system as this one. Twins and hemihedral crystals are frequently found. Char-

acteristic of the diamond we may regard the curving of the crystalline faces. This occurs to so great a degree, that not unfrequently the specimens are nearly spherical.

Physically, we may distinguish three varieties of diamond: the crystal, the carbon and the anthracitic diamond. As seen above, the specific gravity of diamond is 3.52, while that of carbon is 3.01 to 3.40, and that of anthracitic diamond only 1.66. They show slight impurities, as compared with the crystals, but are chemically diamonds as also in their hardness. The carbon is put to practical uses, on account of its comparatively low price and great hardness. Instead of being colorless it is black, or gray, translucent only in very thin slabs.

Chemically, the diamond is carbon. At a high temperature it will burn, and be completely consumed, giving off carbonic acid gas. In an atmosphere of pure oxygen it will burn on, if once ignited. Between carbon points of a heavy battery, the diamond will become spongy, and turn to coals. In 1694 the first experiments of burning it were made. This was accomplished by means of a very powerful lens, concentrating the sun's rays. Much speculation became rife as to the behavior of diamonds under the action of great heat. Emperor Francis I, of Austria, conceived the brilliant idea of converting or melting a number of small diamonds together into one large one. In 1750 he placed a quantity of them, and some rubies, into a crucible, and subjected them to intense heat for twenty-four hours. After cooling, the rubies were found to be intact, but of the diamonds not a trace remained. Shortly before the French Revolution a Parisian jeweller asserted the possibility of exposing diamonds to a very high degree of heat without injuring them. He made his experiments before the famous chemist, Lavoisier. Maillard, the jeweller, had carefully surrounded his diamonds in the crucible with pulverized charcoal, and they withstood the fire perfectly. So long as the oxygen of the atmosphere can be excluded, the diamond cannot burn, and the only harm that might befall it would be a cracking from the heat. This, however, occurs comparatively rarely. Lavoisier, fully convinced by the demonstration, first offered a correct explanation of the phenomenon.

Impurities in diamonds are partly of a physical, partly of a chemical nature. Among the former must be classed cracks and cavities. The latter generally manifest themselves in discoloration

unequally distributed. Yellow, green, brown and gray are the colors most frequently observed. According to Brewster, many of the diamonds showing cavities under the microscope afford evidence, upon polarization, of having been subjected to pressure near these cavities at the time the diamond was crystallized. Such cavities, and slight accumulations of coloring matter were at first erroneously designated as chlorophylloid substances.

Yellow and brown diamonds owe their color probably to a very minute percentage of hydrated ferric oxide. It is an expensive amusement to analyze a quantity of diamonds sufficiently great to determine this point, so we are forced to base an opinion upon other than analytical proof. In the beginning of the nineteenth century a Parisian jeweler heated a brown diamond for some time, and, upon taking it out of the crucible, found that it had burned pink. This color, however, only lasted for about ten days, when the stone turned brown again. Since that time the experiment has been repeatedly tried, often with the same result. The chemical action in this instance consisted simply in driving off the water, so that the iron was contained in the diamond as ferric oxide. This imparts a pink color. Upon exposure to ordinary atmosphere, the original hydrated ferric oxide was again formed.

Green diamonds probably owe their color to an indefinitely small quantity of ferrous oxide. Whether the Dresden diamond is colored by the same material may remain an open question. The shade of green it exhibits is not one that would probably be produced by ferrous oxide. Possibly some organic salt of iron may produce the effect of color.

Gray diamonds usually owe their lack of transparency to the presence of innumerable microscopic cavities.

What the coloring matter of the Hope diamond may be can scarcely more than be guessed at. From analogy we know that certain salts of iron, organic matter and cobalt produce the same color. Which of these it is will most likely remain a secret. At a venture, the salts of iron might seem the most probable, considering the uniformity of coloring and the shade of the blue.

Regarding the formation of diamonds much has been said and written, and many well-conceived experiments have been made. More than any other agent, heat has been employed to reproduce these treasures of nature's laboratory. Thus far all experiments have failed to attain any available result. Some of the most emi-

nent chemists of the present century have expressed the opinion that diamonds owe their genesis not to the action of heat, but to an organic process. Newton, when studying the optical qualities of diamond, came to the conclusion that it must be a "coagulated oil." By means of electricity very minute crystals of carbon have been obtained, but all efforts to reach greater size have been baffled. Liebig regarded the formation of diamond as the result of organic decomposition. Though this view may not be perfectly tenable, it commends itself to the poetical mind from its allusion to the rejuvenated phoenix rising from his own ashes. With an ever-increasing knowledge of chemistry and the constant improvement of mechanical appliances, we may yet, some day, be able to produce diamonds that will compare favorably with those fashioned by the skillful hand of nature.

Practical uses of Diamonds.—Dependent upon its physical properties, the diamond is put to various uses. Perhaps the most prominent is that of drilling. The comparative cheapness of "carbon" makes it possible to utilize this material for such purposes. Diamonds with sharp, crystallized edges are used for cutting glass and small fragments, and splinters are used to arm graver's tools. Dust is employed in cutting other stones as well as the diamond itself. Wherever a substance of very great hardness is required, diamond answers best. On account of its high power of refraction, diamond-lenses were formerly prepared, for the use of very high power instruments. The application of diamonds for purposes of personal or artistic ornamentation, may perhaps be considered a practical one in a certain sense. For such use the total absence of color and the high degrees of refraction and dispersion of light, place the diamond in the most prominent position among all precious stones.

Imitations.—It is natural that a stone so valuable as the diamond should frequently be imitated. Pastes are manufactured to-day, which only a very experienced eye can detect as frauds. Admixtures of lead and, recently, thallium, impart to paste a high angle of refraction, thus producing "flashing" effect very near that of the diamond. Colorless quartz crystals and topaz are frequently cut and are destined to simulate diamonds. Zircon, if heated for a short time, turns colorless from a bright blood-red, and is cut. This too, in smaller settings supplies the place of the diamond.

Quartz and Zircon can readily be detected by the difference of specific gravity. The former is 2.65, the latter 4.30, while

diamond is 3.52. Besides the specific gravity the hardness will be decisive, both can be scratched by topaz. Topaz is more difficult to distinguish. Its specific gravity is 3.40 to 3.65, very near that of the diamond. In this instance, as well as in those of quartz and Zircon, an optical test is the most convenient. In 1858, the Brazilian ambassador Lisboa, presented a "diamond" at the court of Vienna. It had been admirably cut in Paris, and weighed 819 carats. By experts it was valued at more than fifty millions of francs. One of the mineralogists called in consultation applied a very simple optical test, and found the stone to be a topaz. He placed a lighted candle upon a table, walked about 12 to 15 feet away from it, and looked at the light through the diamond, which he held close to his eye. In every facet *two* little flames appeared side by side. As only those crystals have single refraction, which belong to the isometric system (in which the diamond crystallizes) the specimen under question, having double refraction, could not possibly have been a diamond. When looking in this manner at a candle, the diamond, as well as the paste will show but a *single* flame in each cut face. Paste can readily be distinguished by its inferior hardness, as topaz will scratch it.

Price.—The price of diamonds is one that fluctuates, dependent upon the demand and supply. Within certain limits it may be regarded as definite, but when the value of very large stones is to be estimated, the same rules for its determination cannot be followed. Diamonds are usually separated into three classes, and they are termed as being "first water," &c. Besides these three, there is the boart and carbon. These two latter varieties are utilized for purposes of cutting, sawing, drilling, &c. They are sold by the carat as other diamonds. One carat of carbon costs about 6 dollars.

Diamonds used for purposes of ornamentation advance very rapidly in price as their size increases. If, for instance, one carat should cost 100 dollars, six carats will not cost 6×100 dollars, but $6 \times 6 \times 100$ or 3600 dollars. This rule does not apply to inferior stones, but is followed, within certain limits, in determining the value of the best class of diamonds.

Independent of its high price, however, which is always a recommendation to the favor of civilized man, and woman too, the diamond will ever hold its own prominent position, on account of its great intrinsic value.

MOUND-MAKING ANTS OF THE ALLEGHENIES.

BY REV. HENRY C. MCCOOK.

THE following notes are substantially extracts from an article printed in the Transactions of the American Entomological Society.¹ They relate to the familiar mound-making ants which inhabit the mountain regions of the Atlantic States, particularly Pennsylvania. These are insects in form as represented in the accompanying figures, the head and thorax being of a fallow or reddish color, the abdomen a glossy black. There are three forms of workers, the major, minor and dwarf, by whom the entire external economy of the formicary, and for the most part the internal also, is conducted. The females closely resemble the workers-major, but are larger, more robust, and in the virgin state are winged. The males are winged, are smaller than the females, from whom they are further readily distinguished by the smaller head, an additional segment to the abdomen and the different form of the same. In the original paper these ants are referred to as *Formica rufa*, the name which they bear (identified by Frederick Smith, of the British Museum) in the collection of the Entomological Society. They very closely resemble these ants, but on the authority of Dr. Auguste Forel, the author of the "Swiss Ants" (*Les Fourmis de la Suisse*), to whom specimens were sent, they are referred to in the following notes as *Formica exsectoides* Forel, a new American ally. of *F. exsecta*. Their habits do not greatly differ from those of *F. rufa* of Europe, but are nearly if not quite identical with those of *F. exsecta*.



FIG. 1. Worker-Major. The lines beneath the latter figure show the natural length of the three worker forms.

It is further premised that the observations given below were made while encamped in the midst of a colony, or "ant city," of more than 1600 nests, situated upon the eastern slope of Brush mountain, Pennsylvania. These nests are conical elevations of various sizes, the largest measured being fifty-eight feet around the base, twenty-four feet over the top, and forty-two

¹ Vol. VI, 1877, p. 253, sqq. The entire paper is published separately by John A. Black, 1334 Chestnut street, Phila.

inches in height. The mode of building the hills, which are honey-combed with regularly placed tubular galleries, is as follows. The mason work was greatly stimulated by a shower of

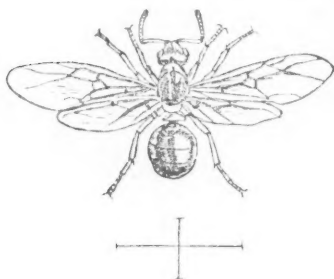


FIG. 2. Female.

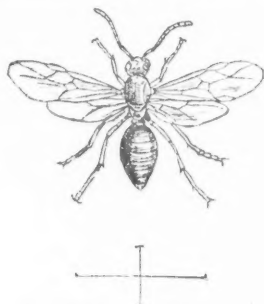


FIG. 3. Male.

rain, and was indeed scarcely observed (beyond excavations of the underground galleries) before the rain-fall.

Building Galleries.—1, Fig. 4 represents a covered way or gallery six inches long, which started on the foundation three or four inches below the surface of the field, and rose up toward the half-

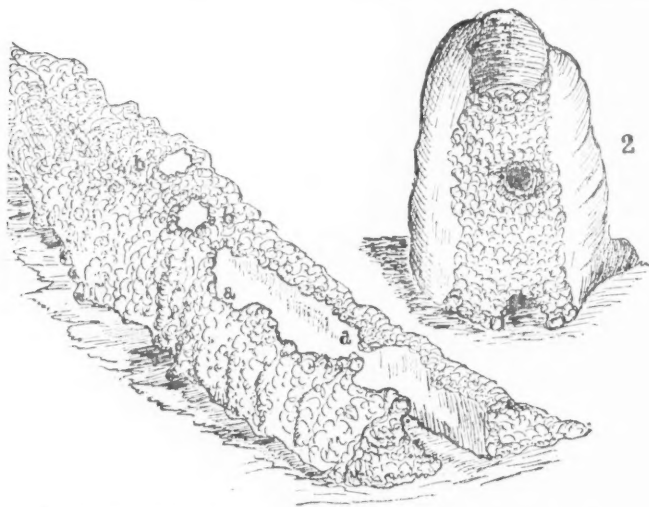


FIG. 4.—Covered Galleries.—1, horizontal gallery; 2, vertical gallery.

cone at an angle a little less than 45° . When first seen it was an open gallery or ditch, and was observed until it was entirely cov-

ered over except one door or round hole near the top. The work progressed by the continuous addition of earth pellets to the outer edge. The pellets were carried in the mandibles of the ants, and were usually pressed into position. The springing of the arch was plainly seen, the two sides slowly approaching each other in irregular lines as shown at *a a*. Gradually two points drew nearer and nearer, until they well-nigh touched. It was quite exciting to watch now the delicate manipulation of the architects. Here comes a worker with pellet of larger size; she climbs the arch, reaches over, holding the while by her hind feet, and drops the ball of soil into the breach. The bridge is made. And now with surprising rapidity it is widened until the roof of the arch assumes the appearance indicated at *b b*. Circular openings or doors are habitually left in the work, through which the ants are moving back and forth, apparently working upon the inside to strengthen the arch. As sections of the building are completed these doors are closed, so that they are plainly but temporary arrangements for the convenience of the masons.

On other parts of the foundation similar structures were going up. At 2, Fig. 4, was a section of a vertical column, one side of which had been cut away. It was two inches high, and one inch across. The ants were working upon this in the same manner as described above. They built not only from the bottom up, but from the sides across. The central opening in the figure was finally closed, leaving, when the work ended, the opening at the foot of the column. The circular gallery thus enclosed was one-half inch in diameter, which is about the usual dimensions. The work of construction was not confined to the space which, as in the above cases, was the original site of the cone. Having occasion to lift up a fragment half the size of one's head, which had been thrown to one side, I saw that the section had already been made the nucleus of a new mound. Columns, corridors and halls, corresponding closely with those outlined upon the under face of the fragment, had been erected, which were thus quite united to the fragment. In one of the halls was a small collection of dead ants. The greater portion of one day was spent in studying and recording the work upon this one hill. Other drawings were made from different positions, but the method and result were the same. As the activity occasioned by the shower

continued for the remainder of our stay, I had full opportunity by subsequent observations to verify my notes.

Fig. 5 is another example of architecture drawn from the same broken hill. The figure represents a double gallery which was built up against the perpendicular side *H* of a hole cut by the spade in removing the cone. The gallery *a a a* was carried along the base of the side three inches, and then upwards toward the surface. The gallery was widened at two points, *c c*, to one and a half inches, as though intended to serve as store-rooms for cocoons. Galleries opening downward communicated with these enlargements. At *c* ants were arranging pellets along a projection on the side, for what purpose was not apparent.

My attention was next directed to a large hill, which with its surrounding hill-cluster was on my regular "list." I took this plan of keeping several hills under regular, daily, and indeed for much of the time hourly observation, for the obvious reason that thus I could become "acquainted" with the workers, could trace the work done, and confirm or condemn previous conclusions as the case might be. In this hill a track had been made by one of a herd of cattle grazing in the field. The foot of the steer had left an irregular depression measuring nine inches each way, in depth eight to nine inches, the lower margin being six inches from the base of the hill.

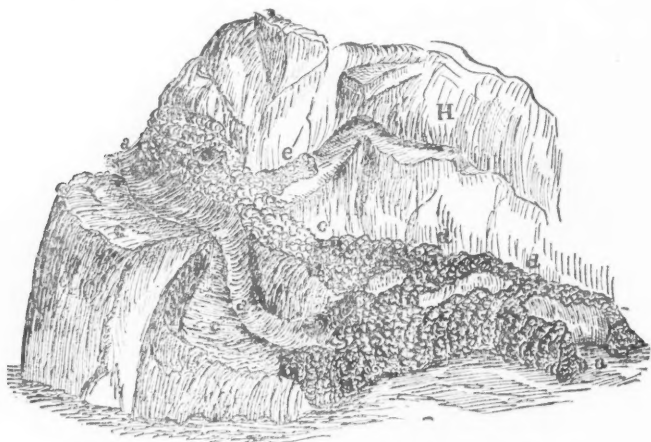


FIG. 5.—Covering a double gallery *a a a*, and chambers *c c c*.

Engineering.—The lower part of this track is shown at Fig. 6,

in order to exhibit what seems very much like a deliberate and well planned system of engineering, in filling up the hole. The drawing is one-half natural size. At *A*, *a*, the original hill is shown, marking the southern limit of the foot-print. The work of filling up against this had begun. From the lower point *A*, marking the outline of an arc, were the following works: *b*, a circular column one inch high, from the upper base of which, a broad bifurcated plateau was being extended; next to this was an oblong mound *c*, one-half inch high, and beyond that, marking the opposite limit of the track, a lunette *d*, one inch high. Beyond this, toward the base of the hill, and parallel with the arc *b*, *c*, *d*, was thrown an arc of like but smaller lunettes *i*, *i*, *i*. At *e* and *f*, were lunettes similar to *d*, and at *g*, a scalloped mound. These elevations, with that at *k*, *k*, surrounded the cavern *h*, which was the deepest part of the cattle-track. The plan of operations is very plain; from the little raised columns and mounds figured above, the work of covering in could proceed with the greatest advantage. The elevations *b*, *c*, *d*, were evidently gauged by the height of the edge of the hill at *A*, thus marking the depth of the track on that line. The diminishing depth was met by a corresponding lowering of the lunettes *i*, *i*, *i*, and at other points in the excavation the same facts held good.

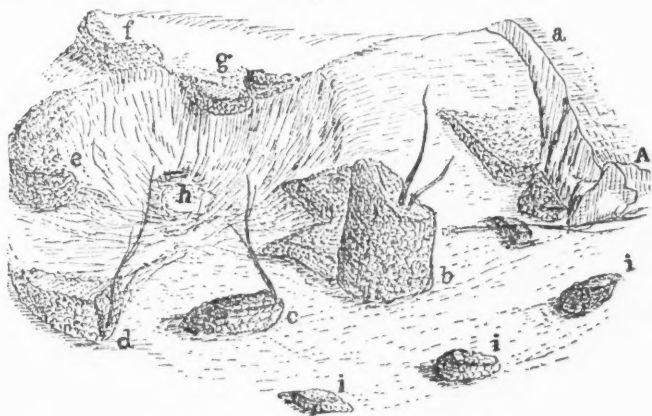


FIG. 6.—Engineering work; filling up a break.

The above operations began on Saturday morning; on Monday morning the cavity was two thirds filled. Very strangely the work did not connect with the face of the break towards the sum-

mit of the hill, but a deep trench or gallery had been preserved all the way across, the wall being maintained intact. Nor was there any appearance here of the formation of the galleries above described; it was dead filling in. In one of the little hollows the shells of cocoons, out of which antlings had just been delivered, were piled up, apparently to assist in the filling. I had before observed these being carried from this hill and deposited on the stones outside. A number of straws were worked into the columns, evidently as braces. A few feet from this large mound was a small hill, one of its off shoots, which even before the rain had shown much activity in construction, for the surface was covered with fresh pellets. The shower had inspired the inmates of this young community with amazing zeal.

Underground Galleries.—Thus far we have been dealing with that part of the formicary which is above ground and is apparently the most considerable. There is, however, a hidden portion which is immense in extent, and must have vast importance in the economy of the community. Every hill furnishes a fair measure of the extent of the underground system of galleries connected therewith; for it is reasonably certain that the entire bulk of soil in each mound has been excavated and brought up from the galleries beneath the surface. The average width of the upper galleries is about three-eighths of an inch; the maximum width not exceeding one-half inch. The underground galleries are probably of the same size. A glance at these mounds, therefore, at once gives indication that an extraordinary system of subterraneous galleries must be connected with each formicary, though I made no satisfactory examination into the arrangement of this system; this might have been done, perhaps, by sinking a deep trench close to a mound and extending it for some distance. But the soil is so very full of stones that even thus the results might not be satisfactory. No doubt the ants descend to considerable depths, utilizing the stones in various ways, for example for roofs and walls, as they do upon the surface. It would hardly seem possible to preserve any great regularity in the course of these underground ways which must constantly be diverted by the stones. But they undoubtedly can be held to a general course, and are carried with great directness from point to point, when it is desired to communicate with the trees and feeding places. I was able in one case to trace the extent of the galleries near the surface in the follow-

ing way. Tapping upon a hill whose inmates were in a particularly "nervous" condition, the ants issued in excited hordes not only from the doors of the mound, but from various points on the surrounding surface. Taking a principal centre of excitement, four or five feet distant, a stone underneath which was an entrance to the galleries, I again agitated the ground. The ants as before issued from the surrounding surface, chiefly upon a line running eastward, up the slope. At the limit of excitement, which was something less than before, I once more agitated the stones and earth with like results. Thus I traced this surface gallery eastward about 60 ft., where the excitement under the above treatment ceased at an oak tree. I am satisfied that as a rule the central formicary or hill communicates with the trees which serve for feeding grounds, by galleries as long as or much longer than this.

Adding Stories.—On the east and west sides of the hill, several inches from the top, deep fissures had been cut, looking like sun cracks, the lower edges of which were being built up, and the upper bent over. An additional story was thus being added to the cone. Here grass-straws were strewn over the summit, and others which I threw upon the hill were dragged into place and utilized with skill. This story was well nigh completed by Monday morning. The building was carried forward (and such was the case on the large hill and on others observed), by erecting warts or small cones upon the surface and around the openings or doors of the galleries, and filling between them. I could trace the evident outlines of galleries laid out.

Entrances or Doors.—The principal entrances to the formicary are at the foot of the hill. They are commonly placed around the entire circumference of the mound, and are arranged in two, three, or more circular rows, one above another. At certain points where, apparently, there is need of an especial vomitory, the gates are much multiplied. Besides these, there are openings at irregular intervals upon the entire surface of the cone. These are not numerous, but sufficiently so to allow easy approach to and exit from the more elevated portions of the mound. The main dependence appears to be upon the lower gateways. It would seem, at first thought, that there could be no real necessity for so many doors; but one who has witnessed the rapidity with which the myriads of workers swarm upon the surface when their nest is attacked will at once perceive the economy of these numerous

gates. The doors are simply the surface openings of the galleries with which they correspond in size.

Huber declares it to be one of the fixed habits of the fallow ant (*F. rufa*), of Switzerland, to close the gallery-doors at night and re-open them in the morning. The most careful attention could discover no such behavior among the ants at Camp Riddle. At no time during the whole week was there observed any sign of attempt to close up the galleries. Even during the heavy storm of rain referred to, the doors which were closely examined at various hours of the night, remained open. It would have been more satisfactory could an observation have been made during a fall of rain in the day time, but I have little doubt on this point, and none at all on the ordinary night-condition of the doors. This is certainly a remarkable variation in habit. It may possibly be accounted for by the presence in Switzerland of some nocturnal enemy, from which the American congeners are free.

Before taking up in detail the life habits of our mound builders, a comparison and contrast may be allowed which may give a popular illustration of the immense labors of the fallow ant. I have calculated the cubic contents of one of the largest hills to be, in round numbers, two millions of cubic inches. Let us estimate the bulk of an ant equal to that of a cylinder three-eighths of an inch high and one-sixteenth of an inch in diameter at the base. We have thirty-five one hundred thousandths of a cubic inch as the bulk of a single ant, or two thousand eight hundred and sixty insects to the solid inch. The size of the builder is therefore to the size of the edifice as *one to fifty-eight thousand millions*. Let us compare this with a corresponding estimate of the work of man (taking his bulk at four cubic feet), as wrought upon the great pyramid, reckoned to contain two hundred and seventy-six millions of cubic feet.

Man's bulk to his building is as 1 : 69 millions.

The Ant's " her " " 1 : 5800 "

The figures are given roundly, without strict verification; they show vastly in favor of the mechanical energy and industry of the insect, if such comparisons may be allowed to show any thing, which is perhaps doubtful. They may serve however to impress some minds more vividly than other methods, with the immense activity which marks the wonderful realm of insect life. The advantage is yet more striking when the period of time consumed

in erecting an adult hill, from 3 to 7 years, is compared with the thirty years which one hundred thousand men spent in building the pyramid. Moreover, as will also appear, the superstructure or hill, is by no means the whole of the formicary. A vast system of subterraneous galleries penetrates the earth to unknown depths and distances, requiring labors which in magnitude may well be compared with those which excavated the catacombs of Rome.

Sentinels.—I observed on the tree-paths a movement that had the appearance of some policy of police. Workers, with the normal round black abdomen, were scattered at intervals along the trunk. They did not seem to belong to the line of ascending foragers, but rather to be stationary, as though they were sentinels or policemen. They were active in challenging with their antennæ the repletes who were on the return, and were quick to resent any interference made by intruding a finger or straw upon the path. This statement is made with reservation, as I was not able fully to satisfy myself that the facts revealed a fixed habit. The point, however, is well worthy of future investigation. There is at least a probability, from analogous habits of the ant, that the individuals referred to above were indeed sentinels as their behaviour indicated. It is a well established fact, in the economy of ant hills, that sentinels are posted at or near entrances, and common avenues of approach. I satisfied myself of this by very many observations and experiments, which it is not necessary to relate in detail. It will suffice to say that on every occasion of approach of any object to a hill or entrance, workers instantly sprang upon the surface. These sentries were constantly seen lurking just inside the gallery doors, whence they issued with every mark of intense vigilance and excitement the moment a finger was intruded or the smallest object dropped near them. Frequently they patrolled the vicinity of the gates. They attacked every intruder with the utmost promptness and intrepidity. It gave subject for great wonder to note the rapidity with which an alarm was communicated throughout a large hill. Two hills in particular, whose inhabitants were for several days in a condition of high nervous excitement, attracted attention. Standing a yard or more from the base, I would agitate with my foot a stone which evidently had communication with the interior of the mound. There was scarcely an appreciable interval of time ere the whole surface of the cone

was covered with insects. The black and red masses whirled in indistinguishable mazes, producing a very perceptible buzzing sound by their rapid movements. Even for several feet beyond the hill, on the opposite side, the excitement extended, and was manifest with almost equal rapidity.

Tree-paths.—The word tree-path, as used above, perhaps needs a brief explanation. It was observed that the ants ascending and descending the trees invariably kept to a beaten track, two or more inches in width. In many cases this track or tree-path was stained, the entire length of the trunk, a brownish-yellow color, caused doubtless by the formic acid which the ants secrete. The position of these tree-paths is determined by the situation of the hill to whose domain the tree belongs, for each community has its own special feeding grounds upon which intrusion is rarely if ever made. The tree-path is located habitually upon that part of the trunk which directly faces the hill. This was verified by observations upon a very great number of trees.

Winter Habits.—There are several inferences, more or less conclusive, concerning the winter economy of the fallow ant which we may draw from the facts. First, the ants dwell within their formicaries during winter, and make no attempt to modify the surface surroundings. Second, the vast majority of the community, together with the fertile queens, larvæ and cocoons occupy the underground galleries. This appears from the fact that but one young queen and comparatively few workers of the various classes were found in the hill galleries. Third, the composition of the mounds is such as to ensure, in the central parts, a good degree of protection against ordinarily severe winters for the few ants that occupy them. Fourth, the vitality of the ants is sufficient to keep them active within the hills during all ordinary seasons. Fifth, it is yet more evident that the occupants of the underground galleries are not torpid during ordinary winters, if ever, but exist in a state of considerable activity. Finally, it would appear that the ants are able to spend the winter in the active state without regular and ordinary supplies of food.

I do not advance this last opinion with any great degree of confidence. The mysteries of the underground galleries still veil the facts that would solve the question completely. But all the known facts point to the above inference. I had thought that the tufts of grass which grow upon many hills, and which evi-

dently grow at the ants' consent, might be preserved, not only to strengthen the architecture, but to furnish at their roots sustenance for aphides. Accordingly, at a visit made October 26, 1876, a cold, snowy day, I carefully searched for aphides upon the roots of the grass, but found none. Mr. Kay's search was equally fruitless. The roaches found in such numbers by Mr. Kay, and also by myself, are doubtless simply squatters upon the emmet territory. However, it must be considered as still unsettled whether our mountain mound-builders feed during winter, and if so, what are the sources of their food supply.

Beetles.—The possibility that the beetles, certain species of which are well known to frequent the nests of ants, might be in some way concerned in this interesting query, did not escape my attention. But I was never so fortunate as to take any beetles in the hills either during the summer or fall visit. This was doubtless chiefly owing to my ignorance at that time of the size and appearance of the insects, and the best mode of capturing them. I hope at another visit to remedy this deficiency. Dr. Horn informs me that the spring is the best season to search for these domesticated beetles. Among the ants collected in mid-winter by Mr. Kay, and sent to me as specimens, I found one beetle. It is a small insect, about one-tenth of an inch in length, of a dark claret-brown color, quite closely resembling in this respect the ants among whom it dwells. It is determined by Dr. Horn as *Tmesiphorus costalis* LeConte, and belongs to the Clavigeridæ. The discovery of this beetle in midwinter, together with the fact that the beetles are found in abundance with the ants in early spring, show these insects to be closely connected with the winter life of the ants, if not with their winter food supply.

Dr. John L. LeConte, so widely distinguished for his thorough knowledge of the Coleoptera, has shown me the following species collected by himself from ants' nests. Two of these, taken from formicaries of our Allegheny Mountain mound-builders, I have been permitted to figure. They are drawn in order simply to give a general idea of their appearance, and not for systematic description. The most interesting of these is perhaps Fig. 7, 1, *Atemeles cava* LeConte, which, like the Clavigeridæ, is furnished with tufts of hollow, hair-like tubes, on the sides of the abdomen. From these tufts a sweet secretion exudes, upon which the ants feed, as upon the honey-dew of the aphides.

A. cava is a brown-colored insect, about one-fifth of an inch in length. Specimens were found with fallow ants in Columbia Co., Pa.; in Michigan, Maryland and Illinois. Those from Illinois were found in nests of *F. rufa* (?) in large numbers. One of the ants taken with the beetle still holds in its mandibles, firmly clasped even in death, one of these household treasures. The other specimens figured are destitute of the hair-like tufts, and probably serve simply as scavengers, or are permitted to remain as "squatters" in the formicary, for some purpose, the economy of which is unknown. *Cedius ziegleri* LeConte, Fig. 10, 2, was taken in a hill of *F. exsectoides* at Bedford, Pa. It has short elytra, the color is brown, the length is one-tenth of an inch. On each of the first pair of legs are two spines, one situated (apparently) at the base of the femur, the other on the trochanter. The remaining specimens were also taken at Bedford, Pa., and are an undescribed species of Homalota, and an unnamed species of Oxypoda. They are small brownish insects, with a slight pubescence.

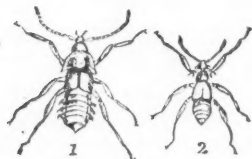


FIG. 7.—Beetles found in nests of *F. Exsectoides*. No. 1, *Atemeles cava* LeConte. No. 2, *Cedius Ziegleri* LeConte.

Lepidopterous larve with Ants.—I introduce here as bearing upon the general matter of ant-food, and the relation of ants to myrmecophilous insects, the following observation. During the early summer of 1877, I had frequent opportunity to note the habits of a large colony of black, shining ants, *Formica fusca*, whose formicary is established at the edge of a grove on the farm of Mr. George B. Lownes, Delaware Co., Pa., nine miles from Philadelphia. The ants were found scattered through the woods, within a circuit of many rods from the nest. June 18th, I observed a column of these ants ascending a young wild-cherry tree, near which grew several tall stalks of the black snake-root or bug-bane, *Cimicifuga racemosa*. While watching the ascending column I noticed an ant moving upon the round blossoms of this plant. Attracted by some peculiarity in its movements I fixed my attention upon it, and saw it to be in attendance upon a small green grub about one-half inch long, which proved to be the larva of a butterfly, probably some species of *Lycenidæ*. The lower segments of the abdomen were continually gently stroked

by the antennæ, in the familiar manner of ants when soliciting honey-dew from aphides. This novel behavior was of such interest that I placed the ant under close continuous observation for more than two hours. During this time the strokes were repeatedly interrupted by short excursions up or down the plant, the ant always returning and renewing the solicitation. The ant always occupied a position below the grub, and directed her strokes toward the head, which, however, generally fell upon the lower part of the body. The larva did not remain stationary, but several times moved its position, slowly creeping around the stem. I ceased observation at noon, and returned to the grove at 4 P. M. The grub was in about the same position, and was attended by the same (or another) ant which was accompanied by a companion. The same behavior observed in the morning was continued until 5 P. M., when I captured ants and grub and took them home. A number of the same larvæ in different stages of growth were found on the same plant in various parts of the grove. I was only able to observe that the ant continued to attend the grub under confinement just as in the woods. But preparations for a journey to Texas, compelled me to suspend observations. Although satisfied that the object of the ants was to secure some kind of refreshment from the larvæ, I was not able to note any secretion on the grub, or anything like the actual taking of food by the ant, although the mouth organs were applied to the last segments.

A casual mention of my discovery was the means of opening communication with W. H. Edwards, well known for his valuable works upon the Lepidoptera, who later in the summer (as I infer), had observed the same fact. In comparing notes it was found that the larva observed by him in West Virginia, was also of the Lycanidæ (*Lycæna pseudargiolus*), and that it was domiciled upon the same plant (*Cimicifuga racemosa*). Two species of ants were seen attending the larvæ, one of which was sent to me and proves to be identical with the European *Prenolepis nitens* Mayr. Mr. Edwards kindly communicated to me the details of his own observations, which he has since given to the public in the Canadian *Entomologist*. As examined by me under the microscope, the larvæ prove to be possessed of organs upon the upper part of the last segments, apparently designed or fitted for the exudation of some fluid. Mr. Edwards also directed my attention to a paper

by M. Guenée, in the "Annales de la Société Entomologique de France," Ser. iv, tome 7, 1867, pp. 665—668, which I have consulted. The paper is brief but exceedingly interesting, and gives a full description, illustrated by figures, of organs found upon the eleventh segment of the larva of the butterfly (*Lycæna batika*), whose protrusion from two openings near the ninth and last pair of stigmata, was observed, and the action and organ figured and described. At the summit of the tenth segment the author found another single opening, placed transversely, and surrounded by a projecting border around which the granulations which cover the whole body of the larva are especially massed. Out of this sort of button-hole, and at the middle, rises, at the will of the grub, a species of hemispherical, transparent vesicle, which gives passage to a serous liquid sufficiently abundant to form a large drop, which is reproduced whenever it is removed. The larva does not secrete this liquid except when disturbed, imitating in this respect the *Cucullia* and many other larvae which disgorge at the mouth a colored liquid, with the intention, doubtless, of repelling those who molest them. M. Guenée ventures no opinion as to the economy of this exceptional structure. But, his description throws great light upon the behavior of the ants as recorded above. There can be little doubt that the gathering of a serous liquid, like that observed by M. Guenée, upon *Lycæna batika*, was the object of the attendance of the ants of *Formica fusca* upon the Lycænid larva as observed by myself. This larva (in alcohol) was placed in Dr. Leidy's hands for ex-

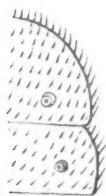


FIG. 8. Glands upon terminal segments of Lycænid larva, attended by *Formica fusca*.

amination, under the microscope. He found on each side of the two (or three) last segments, on the dorsal surface, a prominent, circular, brown-colored glandular looking body, with a central depression. These glands were quite distinct from the spiracles, which are not represented in the accompanying cut. Fig. 8 shows the appearance of these glands as situated upon one side of the terminal segments. It is possible that the last three segments are here represented, the last (twelfth) being contracted. Dr. Leidy found no opening at the summit of the tenth or other segment, corresponding with the button-hole-like secretory gland described by M. Guenée. The above facts are all of very great interest, and may

prove to be another important factor in solving questions concerning the food supply of ants under both ordinary and extraordinary circumstances. Mr. Edwards is now pushing his observations upon the Spring larvæ of this butterfly, assisted by the microscopic skill of Prof. J. Gibbons Hunt, M. D., of Philadelphia.

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THE SMALLEST INSECT KNOWN (PTERATOMUS PUTNAMII).

BY HON. J. D. COX.

THE minute size of this species, which is said to be the smallest insect known, is probably the reason why it has been so little observed, and will justify a somewhat detailed description of a specimen which was caught and mounted in balsam last July.

I was examining the scissor-like mandibles of a leaf-cutter bee (*Megachile centuncularis*), when I noticed upon the surface of the water in which the larger insect was dissected, a mere mite which seemed to have life. Upon transferring it to a smaller cell of water and putting it under the microscope, it proved to be one of the most beautiful little creatures of the insect world, and a rarity which made it no ordinary prize.

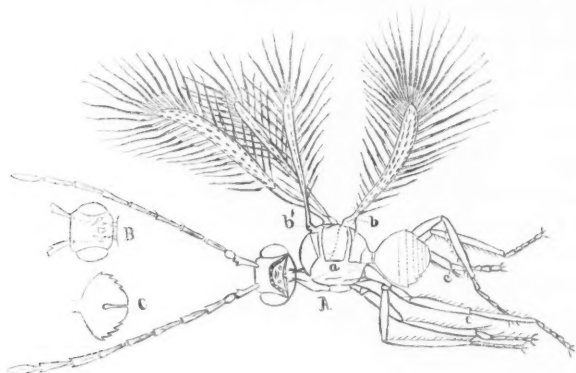
Whilst it was not difficult to identify it as the *Pteratomus Putnamii* from Prof. Packard's description in the "Guide to the Study of Insects," it was also evident that the specimen which the Professor had before him in making his drawing and description, had been injured, and shorn of some of its parts, and that something might be added to our knowledge by putting the "winged atom" in shape for permanent preservation.

The first suggestion as to method was acted upon at a venture, and it turned out a rather lucky hit. A clean slide and cover, and the soft balsam were at hand. Her littleness was taken carefully on the point of a needle, dried against a bit of blotting paper, immersed in a drop of balsam and the cover put on, leaving the arrangement and display of the parts almost wholly to the effects of capillary attraction.

The cut is from an accurate tracing by means of the camera, and except as to the position of the wings, will give at once a correct idea of the little creature. The wings were forced somewhat out of place in the mounting, but with the aid of the binoc-

ular microscope there was no great difficulty in seeing the proper connection and natural places of the parts.

The body was found by micrometer to be twelve thousandths of an inch in length, the antennæ, twenty thousandths. The head is comparatively large and plump, the longitudinal diameter being to the transverse as eight to five. The compound eyes when



seen in outline show eleven facets in section from front to rear; they are of a bright brownish-red color. Three ocelli or stemmata are seen on the top of the head, the middle one lunate in shape with concave side toward the front. These are separated from the forehead by a bow-shaped band having alternately dark and light divisions. The under side of the head with the mouth parts are shown at B in the woodcut, and these last are exceedingly minute. All that can be clearly made out are two curved and pointed mandibles with faint traces of mouth opening, but no projecting ligula or proboscis.

The antennæ are very slender, consisting of ten joints, of which the first curves outward, with a distinct tooth on the inner side near the upper end; the second is oval, being only half the length of the others and broader; the remaining joints do not seem to be perfectly round, but rather four-sided, with points or teeth at the upper end of all except the last, which terminates in a tapering tip.

The thorax is the largest part of the body, equaling in bulk the head and abdomen together. The prothorax, mesothorax and metathorax are nearly equal in size, as may be seen by the divisions of the back which are shown in the figure.

The wings are linear, of sigmoid curvature, with three or more longitudinal lines of minute hairs on the faces, and fringed at the edge with comparatively long ones, which have a black medulla or pith in the greater part of their length, but the inner part, next the body of the wing, is so transparent as to be hardly visible, and gives to the fringe the appearance of being separated from the wing, though with high magnification the hairs can be traced through their entire length. In mounting this specimen the wings of the left side were partly torn from their place and reversed, so that the fore wing is that which is seen in the figure nearest the rear of the body, and the hind wing is that which appears to have its socket nearest the head of the insect. Their proper origin is in fact at *a*, whilst at *b*, careful examination shows a slight projection or shoulder on the fore wing where a corresponding part marked *b'* on the hind wing articulates with it when both are in proper position.

The legs are nearly as long in proportion to the body as those of the common mosquito. The tarsi are five-jointed. The tibial spurs are large and strongly developed on the fore legs, as shown at *c* and *c'* in figure, and opposite them on the first joint of the tarsus the fringe of hairs is very noticeable, which is sometimes called the "comb" in larger insects. The tibial spurs are insignificant on the other legs. The foot-pads or *pulvilli*, with the claws are so minute as to be scarcely distinguishable even under a power of four hundred diameters.

The abdomen is pedicled, and is very short and obtuse, its longitudinal diameter being rather less than its transverse. It is so opaque that the rings can only be well seen at the edge where they appear as in section, and where they have a pronounced appearance of being telescoped, the edges passing beyond each other as if the abdomen had been flattened in the direction of its length. I should have thought this an accidental condition of the present specimen, but for the fact that Prof. Packard found it the same in the one described by him. Five rings can be distinctly made out, with the probability of a sixth, and perhaps a seventh. Upon the under side of the abdomen a long spike-shaped ovipositor is seen, whose form and dimensions are shown in the second outline of the abdomen at *C* in the figure.

This description of the *Pteratomus*, of which all the parts have been carefully verified, corroborates collaterally the opinion of

Prof. Packard, as to its *habitat* as a probable egg-parasite upon the *Megachile* or upon another parasite of this bee, and agrees with the measurement he made of its size and the description of such parts as his probably damaged specimen enabled him to determine, except in an important particular of the wings. In the example before me I find the wings entire, not fissured. This would have induced doubts as to the species had not Prof. Packard himself seen this specimen and concurred with me as to its identity.

It is not improbable that the dissection of other leaf-cutter bees in water, might lead to the washing off and securing of other specimens of this minutest of Hymenoptera, and the beauty of the little insect itself, with its rarity, would well repay the naturalist for some pains in adding it to his collection.

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THE ROBIN'S FOOD.

BY DAVID ALEXANDER LYLE.

ON the morning of May 28th, of last year (1877), I found a robin's (*Turdus migratorius*) nest, about 27 feet from the ground, in a fir tree. It was placed on horizontal twigs near the top. The materials of this nest were the dried blades and roots of grasses. A string over four feet long was found looped around one of the limbs on which the nest was built, but no part of its length was incorporated in the structure. Notwithstanding the protestations of the old birds, I took the ugly-looking thrushlet from the nest and carried it home, with the intention of rearing it to maturity if possible. I procured a large rectangular wire cage, in which, with all due tenderness, I installed my foundling. I furnished him plentifully with stores of boiled eggs and mashed potatoes, mixed as prescribed by those paragons of female character who are self-constituted authorities upon the subject of avian cuisine. I placed conveniently for his use a bath of pure water, and also filled his water-cup. Yet, in the midst of all these delicate attentions, my baby bird steadfastly maintained an air of utter indifference. He neither ate nor drank, but sat, all drawn up on the bottom of the cage, giving vent to an occasional weak chirp. I tried to make him eat by taking little pieces of bread and hard-boiled egg in my fingers and approaching them to his bill after

the manner of the old bird, but to no purpose, his mandibles seemed to be hermetically sealed.

Finding all attempts to coax this exasperating bird to eat in vain, I concluded to forego moral suasion, and try what virtue there was in physical coercion. I opened his mandibles and put small pieces of bread, potatoes and boiled egg so far down his throat that he had to swallow them. I quenched his thirst in a similar manner by pouring a few drops of water at a time into his pharynx. This treatment revived the patient somewhat, but did not give entire satisfaction; I then began feeding him on raw beefsteak three times a day, morning, noon and night, giving him bread and egg in the intervals.

The effect was magical, his eyes brightened, his chirping became loud and vigorous, he would hop about briskly, and continually attempted to get out of the cage between the wires. I found that after eating he became very wild and would not allow my hand to approach him.

He soon learned to open his mouth to receive the food I offered, and henceforth gave no trouble in feeding. I next began to feed him with common earth worms, permitting him to eat nothing else for two or three days. He would eat until his crop could contain no more, then he would retire to his perch, draw down his neck as if suffering, close his eyes, drop his wings a little, and sit perfectly still for about fifteen or twenty minutes. At the end of that time he had digested the worms sufficiently to be ready for another meal. A strictly vermicular diet did not seem to agree well with him, it apparently acted as a laxative. I then alternated between raw beefsteak and earth worms, and found that when he could get beefsteak he would refuse the worms. It being the proper season for June beetles, and as they were easily collected in great numbers, I tried this species as a food, and learned with pleasure that he preferred them to anything else.

Forthwith I procured a wide-necked pickle bottle, and every night had a quantity collected for his daily rations. Henceforth, as long as these Coleoptera could be found in sufficient numbers, they were his sole food.

When they were given him alive he would seize them with his bill, and by vigorous shaking and pounding upon the bottom of his cage, would kill them and remove the elytra before swallowing

them. The delay necessitated by these operations made the time of feeding very long and tedious. When I put a live beetle down his throat he would swallow it, but would exhibit such evident signs of distress that I decided that this process was cruel and unnecessary. I then found that by excision of the prothorax and the removal of the elytra that the operation of feeding was much facilitated. When the beetles were treated in this manner, he would eat from eight to fifteen as fast as I could prepare them. After this he would take a few sips of water and return to his perch, lapse into silence, close his eyes and remain motionless for about fifteen minutes, when he would suddenly become very active and sprightly, hopping about the cage and chirping with much animation. I soon learned that this activity indicated that he was ready for another supply of bugs if offered to him.

From the date of his retention upon an exclusively coleopterous bill-of-fare the change was marvelous. His feathers grew rapidly, he increased in size and cheerfulness, he became more tractable and would allow himself to be petted and handled; but unless he was pressed by hunger he would not touch an earth worm. His mental faculties—if such they may be called—also developed rapidly. He would recognize me in the distance as I approached and would fly to the end of the cage nearest me, calling out in an eager excited note, and would try to get through the wires of the cage.

He seemed to know that he was about to be fed, when he saw the bottle with its store of beetles, and would scream with delight when I approached with it in my hand.

After I had given him three or four he would mount his perch and wait until I could prepare another, all the while watching the operation with evident interest. He would throw back his head and open his mandibles to their fullest extent to receive the proffered beetle from my fingers. His appetite knew no bounds. I was astonished at his voracity. Every day he consumed from forty to fifty of the large beetles commonly known as "June bugs." One morning at seven o'clock I gave him fifteen; I returned from the office at 12 o'clock, and from that time until sunset that evening I fed him all he could eat. During this time he disposed of seventy-two of the large beetles! I have no doubt if I had fed him during the morning he would have eaten a hundred!

By the second week in July the supply of "June bugs" becoming scarce, I had to seek some new edible for my charge. As cherries were abundant I fed him upon this delectable fruit; when hungry he would eat them greedily, but they did not seem to appease his appetite, and were speedily rejected when a few Coleoptera or a piece of raw steak appeared in sight. Whenever supplied with beef or his proper insect food, fruit was invariably discarded. Raw mutton and veal were next added to this bill-of-fare, he cared for neither, and the latter produced the same effect upon his digestive apparatus as did earth worms.

Diurnal and nocturnal Lepidoptera were swallowed with apparent zest, but it was impossible to procure enough of them to satisfy his hunger. Every day I had to eke out his subsistence with beef. On the 25th of July I concluded to set him free, and accordingly, after giving him a small meal of raw beef, I opened the door of his prison and let him go out. He did not go far from the house, but flew around from tree to tree and upon the roof; busying himself catching flies and what small Coleoptera he could find. He evidently made poor progress catering for himself, for about twelve o'clock he flew into the piazza, perched upon the balustrade and appeared very hungry. My wife got a piece of meat and he instantly flew to her, perching upon her shoulder as if imploring something to eat. She placed him in his cage once more, and until August 7th he was not allowed egress. From that date until August 25th he was allowed to spend every day out doors; he always returned toward evening for his beefsteak and was put back in the cage. Although other robins were in the vicinity he evinced no desire to go with them. I noticed, however, that every day he was out he became more timid and appeared to be gradually regaining his feral nature. During the early part of August I collected great numbers of grasshoppers, of which he appeared very fond. The number of Orthoptera he would devour in a day was simply astonishing. He now appeared to be fully grown.

August 25th was a damp, cloudy day, with frequent light showers. He was let out of the cage at the usual time, about eight o'clock, and was not seen again. Whether he had been frightened off to some distance and did not know the way back or whether he had concluded to trust his chances in the "wide, wide world," I never knew.

I observed that when at large and hungry, this robin would eat flies, moths, ants and worms, but never seemed to be able to obtain enough to satiate his inordinate appetite.

When I found my search for beetles so poorly rewarded, I directed my attention to observations upon the feral members of the genus *Turdus*, to learn, if possible, whether or not their exertions were more fruitful. I found that they had about as much difficulty in procuring a livelihood as I had for my feathered ward. I also noticed that they were only frugivorous when driven by hunger and the lack of an adequate supply of insects. That robins were strictly insectivorous as long as the supply was equal to the demand, and that they did not like Colorado beetles as an article of food. And, lastly, for every cherry or grape they ate, they destroyed thousands of injurious insects.

In the Armory grounds twenty-three pairs of robins were known to be nesting in one month. And since the young robin whose gastronomical feats have been narrated above, was found capable of eating seventy-two large beetles in one day, it is not unreasonable to assume that each bird would destroy at least one hundred insects per day, taking them as they come, small and large. Therefore, the forty-six birds known to feed on these grounds and vicinity, would require 4600 insects per diem, or in thirty days they would despatch the large number of 138,000 insects! This quantity at first glance may seem to be a very large estimate, but when it is remembered that each pair had a nest containing from one to four young which required food, and that have not been included in the above, it will be apparent, that it is rather an under than an over-estimate.

Taking into consideration the rapid, and in many species marvelous reproduction and increase of insect life, it will be seen that robins must exercise a considerable influence upon the entomological world, by preventing an undue increase of those species upon which they feed. When driven by hunger, and then only, in the opinion of the present writer, do these beautiful, sprightly birds attack our small fruits.

Upon a small cherry tree near my house, to which these birds had undisturbed access, only about one cherry in twenty was found to be molested. Even had the loss been greater, how small would it be in comparison to the myriads of noxious insects destroyed annually by these feathered guardians alone. Still, we

hear the crack of the gun wielded by the wanton hands of thoughtless boys and ignorant men, which announces to our ears the painful fact that another of our most useful friends has been murdered. It is none the less murder, because it is called "sport." It is to be hoped that the efforts of our naturalists will eventually be successful in rendering apparent to our law makers the necessity for more stringent protective laws with provisions for the sure and speedy punishment of the avicide.

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THE RUNNERS OF ERYTHRONIUM AMERICANUM.

BY EDWARD POTTS.

THE botanist or amateur flower collector who wanders at this season of the year (early in May) along the woodland stream or loamy hillside, can hardly fail to observe numerous colorless stems, forming, as it were, little loops three or four inches in length, on or near the ground, both ends being buried beneath the surface. If his curiosity should lead to a closer examination, he will find that while one end is firmly rooted, the *other* yields readily to his effort to withdraw it, and proves to be, not a root, as he may have at first supposed, but a stem, smooth and of uniform diameter, excepting at the end, where it enlarges into an oval knob, which, later in the season, is further developed as a true bulb, and ultimately planted by the growth force of this slender stem at the depth of three or four inches in the loose wood-mould. If he should trace the same stem backward, carefully loosening the earth to avoid breaking it, he would find that it had its origin with two or three others, in the lower extremity of a similar bulb, pear-shaped, somewhat flattened, perhaps one-half an inch long by one-quarter in thickness, to the upper end of which may still cling a single withered leaf. Should he visit the same locality a few weeks later, he will find that leaf and stems have both disappeared and that the little bulb he saw in the process of being planted by such a deft and delicate finger has thrown out a radiating group of roots from *near* the lower end and, showing no other signs of growth, has evidently settled itself to await the developments of another Springtime.

A whole year is a long time for our botanist to wait the solution of his problem as to genus and species; so we will anticipate the result of his observations next year. The April sun will hardly have begun to warm the south fronting hillsides, ere our

sleeping bulb will waken and reach up into the moist spring air a single glossy leaf, spotted or blotched all over with spaces of darker shade, which he will then recognize, or any child could tell him, is the sterile condition of his misnamed though favorite Dog Tooth Violet (*Erythronium Americanum*).

Soon after the leaf has fully developed, spreading forth its rich juices to the influence of sun and air, three or four stolons or runners, such as already described, will protrude at the lower extremity of the bulb, and, promptly turning upwards, will be seen bursting through the surface of the ground, reaching up an inch or two into the air and then in a wavering, uncertain way burying themselves again in the earth to plant the bulb that shall repeat the same process next year.

As is well known, in its single leaf condition this plant never blooms. In this *second* year of its existence, therefore, the bulb cannot have fulfilled its whole mission; if, and we admit it to be an assumption not proven, the law of nature would give to every individual at least the *chance* to reproduce itself by means of perfected seed. By the *third* year, then, we presume the bulb will have attained the strength necessary to enable it to send up two leaves and a flower stalk and become what it should have been called, a lily indeed, with its pendulous golden bell.

In the lily family, propagation by means of lateral or axillary bulbs (as a compensation, perhaps, for the frequent failure to perfect their seeds) is familiar to every one; but I cannot find that these partially aerial runners of the *Erythronium*, by which it projects its bulbs sometimes to the distance of a foot from the parent plant, have been previously noticed. It may be well to add that these observations refer especially to one locality in what is known as Sweet Briar Glen, Fairmount Park, Philadelphia; that the mode of propagation described, is the universal habit of the plant, the writer is not prepared to assert.

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THE MODE OF EXTRICATION OF THE AMERICAN SILK-WORM MOTH.

BY D. C. MCLAREN.

SHORTLY after reading Dr. Packard's article in the June number of the "NATURALIST," it was the writer's good fortune to observe the entire process of extrication in the case of a large and fine male specimen of *Telea Polyphemus*.

My attention was attracted by a rustling in my box of cocoons. The noise was traced to a cocoon which had been nearly flattened out during its previous sojourn in my coat-tail pocket, and whose development was, therefore, a surprise. I carefully cut an opening about a half an inch long, and a quarter wide on the top of the cocoon. The same method, I afterwards found, was employed by Mr. Trouvelot. I did not cut the flap entirely off, but left it so that the cocoon could be opened and closed at pleasure. All the motions of the chrysalis could be distinctly seen and studied. The back of the pupa had just begun to split. The positions of the "cocoon-cutters" were plainly marked by a pair of black protuberances on the shoulders. The end of the cocoon was *well moistened*.

The first motion was up and down. The chrysalis resting on its head and tail, arched its body so that the middle of the abdomen was thrust upwards. The object of this seemed to me to be the loosening of the moth from the pupa skin. This motion lasted about an hour, at the end of which the second motion began; this consisted of a rotatory movement. Now, for the first time, the head was pressed against the end of the cocoon. The gloss was rubbed off of the moistened portion, and the strands of silk much loosened by this boring process. Both these motions were accompanied by a slight rustling, largely due, I think, to the crackling of the cast-off larva skin.

All the preparations for exit having thus been made, the remaining steps were quickly taken. The body of the moth came to rest, its wings were drawn up from their cases by a shrugging of the shoulders, if I may use the expression, which describes the motion exactly. The shoulders were then drawn together as nearly as possible, and, while pressing against the cocoon, thrust apart with considerable violence. A tearing sound was now heard, entirely different from any which had preceded it. The cocoon-cutters, though not visible from my "coign of vantage," could be distinctly felt through the wet cocoon. Turning a little, the operation was repeated. After several repetitions, a weak spot was found, where the cutters were forced through. The small opening was quickly enlarged, the back of the thorax and the shoulders were thrust through, followed by the head, antennae and fore-legs, in the order named. The remainder of the task was readily accomplished, and the perfect insect emerged two hours from the beginning of my observations.

I am by no means positive that the silk was actually broken by the cutters. It may have only been pushed aside. Without the aid of these little instruments, however, it is difficult to see how our moth could have forced its way through the prison walls of its own construction. It was a noticeable fact that the legs took no part in the process of extrication, but remained folded inactive on the breast. The cocoon-cutters might easily have escaped the notice of one not expecting their appearance, or, if seen, they might readily be mistaken for legs, by one who did not know of their existence.

The moth was much longer than usual in developing its wings, so that the period assigned for this extrication may be above the average.

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MOQUI FOOD-PREPARATIONS.

BY EDWIN A. BARBER.

THE *pee-kee* (*piki*) or Moqui bread is a thin tissuey substance of a greenish-blue color; the sheets measure about two feet by a foot and a half, and are usually folded twice, at right angles. The successive bundles or horizontal layers resemble, more than anything else, piles of blue silk of a coarse texture. This *piki* is brittle and very palatable, but a great quantity is required to satisfy one's hunger.

The flour or meal, of which the *piki* is made, is usually ground by the women. The mills consist, in almost every instance, of three stone boxes, probably a foot and a half square, and about eight inches in depth. In each compartment is a smooth stone, fitting the bottom, but inclined from the back to the front. Behind each of these mills (*metates*) a woman, by means of a long grinding stone, rubs the grain which is placed on the *metate*. The grinders are usually a foot in length, four or five inches in width and an inch or two in thickness. The corn flour, or "*ngum-ni*," as it is called, is of two qualities; the *pink* or *bluish*, and the *white*. The corn raised by these people scarcely grows to the height of two feet and the ears are short and small, the grains being either white, or red and blue, somewhat resembling that which we call here Mexican or pop-corn. The white corn is converted into a white flour, which compares favorably with our finest brands of corn meal; the red and blue corn is ground into a coarser powder, of a pinkish tint, for ordinary use. From this

latter the *piki* is generally made, although it is occasionally made of the white, and, in fact, is produced of every intermediate shade of color. In all of the houses, I noticed large quantities of corn, dried and stowed away like cord wood, or hung from the rafters in great bundles. This precaution is taken in order to prepare for a famine, as the ordinary means of subsistence of the Moquis is precarious at best. Being an industrious race, they are, as a consequence, provident, so that in time of long protracted drought their supplies of corn, dried fruits, vegetables and meats would be ample to carry them safely through the siege.

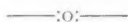
The labor of making *piki* falls to the women, and is indeed a singular process. The female, after grinding the meal, mixes it with water in a large earthen bowl, when a thin blue paste is obtained. Into this is sprinkled a small quantity of cedar ash. The baker then sits or kneels before a stone oven, with the vessel containing the batter by her side. The oven consists of a large, flat, polished stone slab, some two feet long, a foot and a half wide and three or four inches thick, placed horizontally and raised a few inches from the floor. Under this a fire is kindled, and when the stone becomes hot it is ready for use. First it is greased, and then the woman dips her hand into the substance and smears it rapidly over the entire surface of the stone in a thin layer. In a few seconds this is peeled off and placed on a corn-husk mat. When a number of these sheets have been baked, and while they are yet warm and pliable, they are folded together twice and constitute a loaf. Many of these loaves are made at one baking, and when they are finished are placed on a shelf, ready for use. I have observed one woman make as many as a dozen heaping baskets of *piki* in a short time. In eating it, pieces are broken off with the hand, as it is too brittle to cut. It has a peculiar taste, although the corn flavor is prominent, and a relish for it is soon, if not immediately, acquired. Another food preparation which is made by this interesting tribe, is a mixture or hash of dried fruits, chopped meal and *straw*, which is formed into little flat, circular cakes, four or five inches in diameter, and these are then placed on the roof to dry. This *toom-e-tóch-c-née* (tum-i-lák-i-ni) is the most repulsive looking conglomeration conceivable.

During the summer, pumpkins and melons are cut up and dried, which, when used, are said to be pleasant to the taste.

One evening I had the opportunity of attending a Moqui repast,

having been invited by the *cacique* or governor of the town of *Gualpi*. As soon as we had ascended to the roof of the first story of the house, we were directed to be seated on robes, and forming a circle with our legs tucked under us, Turk-fashion, a huge earthen bowl of dried pumpkin soup was placed before us. Into this, each of us thrust the first two fingers of either hand, in turn, and raised it to our mouths. The second course consisted of the *piki*, which was followed by dried fruits and meats.

The manner in which corn is sometimes served is an excellent one. When in the milk, it is cut down raw and the pulp made into little cakes and rolled up in the husks. This is then either boiled or placed in the ashes to roast, but in either form it is particularly agreeable. In every house we entered, we were treated in a most hospitable manner. The Moqui bread was invariably set before us, after robes had been spread for us to sit upon.



RECENT LITERATURE.

JORDAN'S MANUAL OF THE VERTEBRATA.¹—This work fills a unique place in our educational and scientific literature, and our formerly published anticipation that a new edition would soon be called for, is now realized. It is simply the only book which can be used by the teacher or scholar in imparting or acquiring a knowledge of perhaps the most important branch of biology, as represented in the north-eastern quarter of the United States. It does not aim to do more than furnish a basis for the simple recognition of the species of the *Vertebrata* of this region, together with the groups of all ranks into which they naturally fall. In this effort the author is mainly successful. The definitions are concise, and generally exclude all but essential features. This is a merit not to be lightly overlooked, in view of the proneness on the part of many writers to mingle the non-essential with the essential, and to produce a prolixity very confusing to the student. Of course, where the author adopts names which do not represent things or ideas—which in some instances he does, in deference to authority, we suppose—definition is impossible. In these, and in some others where there is some practical difficulty in the observation of the true characters, definitions of a trivial nature are employed. We allude especially to such generic definitions as consist of qualities of color and size; characters which are essentially specific, and must always be so. This has been done in

¹ *Manual of the Vertebrates of the Northern United States, east of the Mississippi river and north of North Carolina and Tennessee, exclusive of Marine species.* By Prof. D. S. JORDAN. Svo, pp. 401. Chicago. Jansen, McClurg & Co. 2d edition, 1878.

some families of the birds where the genera have been too greatly multiplied; e. g., in the *Strigidae*, *Icteridae*, *Fringillidae*, *Hirundinidae*, *Corvidae*, *Tyrannidae*, *Ardeidae*, *Anatidae*, etc. As a model of really diagnostic analysis we refer to that of the *Falconidae* (p. 110), where the divisions, whether all generic or not, receive the characters which belong to them in the system.

The most valuable part of the book is that relating to the fishes, where the ichthyologist, as well as the beginner, can obtain important information. Prof. Jordan's original work having been chiefly in this field, where he has added materially to the science, we have here the latest results as to species and genera, and their distribution. This work is, then, the only hand-book of the ichthyology of our fresh waters which we possess. A useful review of the North American species of *Salmo* is given in an appendix. This has been much needed, as the carelessness and incompetency of amateur writers has been especially displayed in the literature of this popular genus. Fifty-three nominal species are here reduced to seventeen, the reduction being greatest in the Pacific coast salmon, where Suckley wrought such confusion. We are also glad to see those myths, *Salmo confinis*, *S. symmetrica*, *S. toma* and *S. adirondacus* finally laid. We wish we could say the same for the barbarous names employed for the Pacific *Salmones*. Such names as "*gorbuscha*," "*nerka*" and "*keta*" should have a very good diagnostic basis to admit them to toleration. A similar synopsis of the species of *Coregonus* follows. These are referred to four genera, a proceeding, as appears to us, not warranted by the facts.

We recommend this work to teachers and students of North American zoölogy as a *sine qua non* in this department.

PROCEEDINGS OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, September to December, 1877.—This number forms a volume of one hundred and seventy pages, which are occupied as follows: List of members, correspondents and officers, 48 pages; indices 18 pages; reports of officers 69 pages; short verbal communications on scientific subjects 30 pages; scientific papers 8½ pages. Of the last there are three, the conclusion of Prof. Jordan's description of the catostomid fish, *Lagochila laccra*; description of a new *Helix*, and a valuable discussion by Mr. J. A. Ryder, of the relation existing between the structures and uses of the incisor teeth of rodents. The list of contributors of papers during the year 1877, includes twenty-two names, of whom seven are resident members of the Academy, and four of whom appear to have based their work on specimens in the museum of the Academy.

A novel feature introduced into the proceedings during the last few years, has been the "Report of the President." An annual President's address, which gives a review of the progress of science during the year, is a usual feature of the publications

of scientific bodies, but the present "Report" consists chiefly of a discussion of the financial condition of the society, a duty which is usually left to the treasurer to perform. As to its subject matter, we have to observe that little or nothing is said respecting the fostering of scientific research, in any practical way; but money is asked for, to be expended in erecting a new building, and in payment of persons to catalogue the books and to label and catalogue the specimens in the museum. No notice is taken of the comparatively inconsiderable additions to the museum during the year, as indicated by the reports, nor of the fact that the determination and labeling of the specimens has been mostly confided to persons having little or no knowledge of the necessary departments of natural science. The president remarks: "Promptly mounting, labeling, and displaying specimens in the museum as fast as presented, can no longer be safely confided to volunteer and gratuitous labor alone. There is constant occupation for two or more experts for whom a reasonable compensation is essential." There is a *naïveté* in these expressions which is surprising as coming from a president of what was once the most efficient scientific body in this country. The supposition that specimens in any department of natural science which has not been thoroughly exhausted, can be "promptly mounted, labeled and displayed," could scarcely be entertained by the humblest student of science; and the expectation that even "experts" would pursue scientific research for the purpose of "displaying specimens in the museum as soon as presented," shows that the president of the academy is in a state of lamentable ignorance as to the real object of its existence. The idea that it is a show museum, appears to have entirely excluded the true view of its founders, and of all of the scientists who have built it up, viz: that it is an institution of original research. With this fact in view one can understand how the "volunteer and gratuitous labor" of its scientific members cannot be "safely confided" in, and how the places of such members have been supplied by employés who make no pretensions to scientific knowledge or reputation.

It also explains how the only moneys available for the payment of salaries, have been devoted to the employment of such persons, while tens, nay, fifties of promising young students or mature men of science throughout the country, who are struggling with poverty, would consider such positions as placing within their reach the realization of their highest aspirations.

In view of these facts the President's remarks on the subject of Professorships (p. 324) impress us as inconsistent. He is primarily in stating that one of the objects of such an officer would be to give "systematic courses of instruction," if by this, complete courses such as are required by our schools, is meant. The object had in view by the proposers of this part of the organ-

ization was simply to offer to those meritorious scientists who were performing volunteer labor in connection with the Institution, positions which would enable them, each in his department, to develop his science, and at the same time the collections and publications of the Academy. Endowment, while very desirable, was not regarded as more indispensable now than in the past, which had been adorned by numerous able volunteer laborers. The fact that the expenses a little exceed the receipts in the case of the single gentleman appointed to a professorship, does not demonstrate, as the President thinks, that the scheme as adopted two years ago, cannot be realized; for his conclusion is at least forgetful of the gentlemen who subscribed the small deficit.

To the latter class, the liberal citizens on whom progress so much depends, we would say:—that if the Academy is to occupy the position as a means of development of the natural sciences which she ought to hold, it will not be by the adoption of the policy maintained in this report. The results of that policy, as seen in the collections and publications of the Academy, are sufficiently well known. Endowment of original research does not mean creation and maintenance of show museums, or the building of fine houses. It can only be accomplished by putting right men in their right places, and furnishing them with the means of making the requisite collections, researches and publications. And in order that these means be expended in profitable directions, scientific institutions must be officered by scientific men. To pay salaries to unscientific men to do scientific work, or to pay for the publication of such reports as go to make up the bulk of the volume before us, is, in our estimation, a diversion of money from its proper object.

THE ANCIENT LIFE HISTORY OF THE EARTH, BY DR. NICHOLSON.—¹This book is, as stated by its author, primarily intended for the student, but the style has been adapted as far as possible, to the wants of the general reader also. While the former object is quite attainable in a work like the present, the latter is more difficult of accomplishment. Popular palæontology implies a greater knowledge of zoölogy than the general reader usually possesses, and the subject can only be rendered intelligible by a greater amount of zoölogical analysis or statement, than we find in the present work. The excellent illustrations given by Dr. Nicholson do a great deal towards rendering the names in the text comprehensible to the reader of this class. The general remarks, both preparatory and final, are sound, and the references to the literature of the subject extend the opportunities of the student beyond the field to which the work is necessarily confined. We only notice two faults, viz: the omission of the strati-

¹ *A comprehensive outline of the principles and leading facts of Palæontological Science.* By H. ALLYNE NICHOLSON, Prof. Nat. Hist. Univ., St. Andrews. D. Appleton & Co. 8vo. pp. 408.

graphy of the interior of the North American continent; and the adoption of some of the pseudonyms of American vertebrate fossils, which have latterly become current in some quarters. Such are *Dinoceras* and *Brontotherium*, which it is well known in this country have never been distinguished as genera from the old *Uintatherium* and *Menodus*.

MATERIAL FOR A BIBLIOGRAPHY OF NORTH AMERICAN MAMMALS.¹—This work covers 132 pages of closely printed quarto of the series of final reports of the Hayden Survey. It includes references, by page and date, to all works and papers, large and small, which relate to the *Mammalia* of North America, both recent and extinct. Such a work as this, if well prepared, must be, it is easily perceived, most invaluable to the student in this extensive department, as well as to all persons desiring access to any part of it. After a critical examination of its contents we can say that it fully justifies the reputation of its authors for fullness of research and accuracy of statement. Its arrangement is well calculated to meet the needs of the student. The first division includes general works; the second, those on faunæ and distribution. Then follow the orders of the class, each constituting a division; and papers received or discovered during the compilation of the preceding part of the work, complete it. In the case of extinct *vertebrata*, lists of species described in the respective papers are given, which is an obvious convenience; while the arrangement is chronological. The date of publication is usually given to the day, but a few omissions in this regard are noticeable. We recommend this work as an index to the subject of Mammalogy, which no student can be without.

KING'S GEOLOGICAL EXPLORATIONS OF THE FORTIETH PARALLEL.—The second and fourth volumes, and atlas of geological maps of this important Survey, have lately appeared from the office of the United States Engineers, War Department. 1877. Volume ii. is entitled Descriptive Geology, by Arnold Hague and S. F. Emmons. It is illustrated by twenty-six photographs of the more remarkable scenery along the Union and Central Pacific Railroads, from Wyoming and Colorado to the Sierra Nevada, and is of particular value as giving a detailed description of the geology of a region often visited by travelers and scientists, while the work will eventually prove of great economic importance.

The fourth volume contains, Part i., Palæontology, by F. B. Meek; Part ii., Palæontology, by James Hall and R. P. Whitfield; Part iii., Ornithology, by Robert Ridgway. We have noticed the latter work elsewhere. The posthumous work of Mr. Meek is illustrated by seventeen plates, representing fossils from the

¹ Appendix B of the *Monographs of the North American Rodentia*, by Dr. COUES and Mr. ALLEN, of vol. ix. final Report U. S. Geol. Survey Teams, under Dr. F. V. HAYDEN. By Prof. THEODORE GILL and Dr. ELLIOTT COUES.

Silurian to the Tertiary; while the portion by Messrs. Hall and Whitfield refer to Palaeozoic, Triassic and Jurassic fossils, and is illustrated by seven plates. The atlas of maps is of great beauty and value, and worthy of this famous Survey.

UNITED STATES FISH COMMISSION.—The report for 1875-76 of Prof. Baird, U. S. Commissioner of Fish and Fisheries, forms a bulky volume of over a thousand pages, and is, like the preceding ones, of great practical value. Besides the report of the Commissioner is an appendix containing a valuable history of the American whale fishery from its earliest inception to the year 1876, by Alexander Starbuck, comprising 768 pages; E. W. Nelson reports on the fisheries of Chicago and vicinity; Livingston Stone on the salmon fisheries of the Columbia river; Dr. C. C. Abbot on some fishes of the Delaware river; R. Hessel on the carp and its culture, and its introduction into America; J. W. Milner reports on the propagation and distribution of shad; C. E. Atkins on the collection of eggs of Schoodic salmon in 1875 and 1876; and Livingston Stone finally states the results of operations on the M'Cloud river in salmon breeding in 1875 and 1876.

LEUCKART'S HUMAN PARASITES.¹—We feel sure that we shall do some one a favor, even at this late hour, in calling attention to this valuable and exhaustive work on parasitic worms. It is the most recent and trustworthy work the physician can obtain, and it is to be hoped that an English translation will soon appear, though Cobbold's Entozoa is most excellent in its way, and the best English work on the subject.

RECENT RESEARCHES ON THE NERVOUS SYSTEM OF THE HYDROZOA.²—The work before us is one of the most important contributions to our knowledge of the nervous system of the pelagic Medusæ that has ever appeared. The investigations were principally confined to the *Geryoniidae*, *Trachynemidae*, *Aeginidae* and *Aequoridae*. The conclusions which the authors arrive at are of the highest significance in relation to the question of the origin of the nervous system and sense organs in the higher forms. They find here, as Schulze has proved in the case of the higher animals, that the terminal elements of the sense organs—touch, hearing, etc., are of epithelial origin, and also that the ganglionic and intermediary fibrillar system is of ectodermal origin; further, that the termini of the motor nerve system were likewise primarily epithelial and at first formed part of the ectodermal covering of the animal.

The delicacy of the tissues that these investigators have had to deal with renders their manipulation difficult, but the results at-

¹ *Die Menschlichen Parasiten und die von ihnen herrührenden Krankheiten. Ein Hand und Lehrbuch für Naturforscher und Aertze.* Von Prof. RUDOLF LEUCKART. 2 Bände. Leipzig und Heidelberg, 1863-1876. 8vo, pp. 766, 882. With numerous woodcuts.

² *Das Nervensystem und die Sinnesorgane der Medusen Monographisch dargestellt.* Von OSCAR und RICHARD HERTWIG. 4to, pp. 186. Taf. 10. Leipzig, 1878.

tained are best appreciated by reference to their very excellent plates, where the relations spoken of can be readily seen. The resemblance of the peripheral sensory cells to the analogous organs in the vertebrates is very striking, and shows in a most forcible manner that organs which subserve similar purposes, even in widely separated classes of animals, are developed in very similar ways and into very similar forms. The fact of their epidermal and ectodermal origin is rich in its bearings upon an explanation of the development of the nervous system of the vertebrates, where as here the organs of percipient relation are of ectodermal origin, with the super-addition of a highly developed psychic ganglion, the brain, which, no matter what may be the argument to the contrary, can boast a no more aristocratic parentage than the rest of the nervous system.

RECENT BOOKS AND PAMPHLETS.—Annual Report of the Entomological Society of Ontario, for the year 1877. By W. Saunders, Rev. C. J. S. Bethune, B. Gott and J. Williams. Toronto, 1877. 8vo, pp. 59.

Bulletin of the U. S. National Museum, No. 10. Contributions to North American Ichthyology, based primarily on the collections of the U. S. National Museum. II. By D. S. Jordan, Washington, 1877. 8vo, pp. 120. 45 plates.

On the Superficial Geology of British Columbia. By G. M. Dawson. (From the Quarterly Journal of the Geological Society of London. Feb., 1878.) 8vo.

Notes on the Oceanic Copepoda. (Extracted from the Appendix to Capt. Nares' forthcoming Arctic Voyage.) 8vo, pp. 5. Ten Days Dredging at Oban. (Extracted from the Quarterly Journal of Conchology. Nov., 1877.) 8vo, pp. 4. On the new British Nadibranchiate-Mollusca. (From the Annals and Magazine of Natural History for Dec., 1877.) 8vo, pp. 3. Note on Telaginopsis (Polycerias Hincksii); and on the Circumpolar Distribution of certain Hydrozoa. (From the Annals and Magazine of Natural History for March, 1877.) 8vo, pp. 4. By Rev. A. M. Norman, M. A.

Bulletin of the University of California, No. 32. On the Destruction of the Ground Squirrel by the use of Bi-sulphid of Carbon. April, 1878. By E. W. Hildgard. 8vo, pp. 6.

Bulletin of the University of California, No. 31. The Rainfall in California, its Distribution, its Periodicity, and its Probabilities. Feb., 1878. By G. F. Becker, B.A., Ph.D. 8vo, pp. 10, with diagrams.

On the Genus *Actinometra* Müll., with a Morphological Account of a new Species (*A. polymorpha*) from the Philippine Islands. By P. Herbert Carpenter, B.A. (Extracted from the Linnean Society's Journal. Zoology, Vol. xiii.) 8vo, pp. 17.

Die Kometenform der Seesterne und der Generationswechsel der Echinodermen. Von Ernst Haeckel. (Abdruck aus der Zeitschrift für wissenschaftl. Zoologie, xxx, Bd. Suppl.) 8vo, pp. 25. With a Plate.

On some Points in the Anatomy of *Pentacrinus* and *Rhizocrinus*. By P. Herbert Carpenter, B.A. (From the Journal of Anatomy and Physiology, Vol. xii.) 8vo, pp. 18.

Die Bewegungen der fliegenden Fische durch die Luft. Von Karl Möbius. 8vo, pp. 40. With a Plate.

Notes on the Petrography of Quincy and Rockport. By M. E. Wadsworth. (From the Proceedings of the Boston Society of Natural History, Vol. xix. Feb., 1878.) 8vo, pp. 8.

Ueber die Schmuckfarben der Daphnoiden. Von August Weismann. (Separat-Abdruck aus Zeitschr. f. Wissenschaftl. Zoologie, xxx, Suppl. 1.) 8vo, pp. 43. With a Plate.

Description of new Genera and Species of Isopoda, from New England and adjacent regions. By Oscar Harger. Brief Contributions to Zoology from the Museum

of Yale College. (From the American Journal of Science and Arts, Vol. xv. May, 1878.) 8vo, pp. 7.

Manual of the Vertebrates of the Northern United States, including the district east of the Mississippi and north of North Carolina and Tennessee, exclusive of Marine Species. By David S. Jordan, Ph.D., M.D. Second Edition, revised and enlarged. 8vo, pp. 407. Chicago: Jansen, McClurg & Co. 1878.

Memoirs of the Geological Survey of India. Palæontologica Indica. Indian Tertiary and Post-Tertiary Vertebrata. Vol. i, 3. Ser. x, 3. Crania of Ruminants. By R. Lydekker, B.A., of the Geological Survey of India. 4to, pp. 84, with Pls. I-XXVIII. Calcutta, Government Press, 1878.

Die Kometenform der Seesterne und der Generationswechsel der Echinodermen. Von Ernst Haeckel. (Abdruck aus der Zeitschrift für Wissenschaftliche Zoologie. XXX. Band. Suppl.) Mit Tafel XX. 8vo, pp. 424-425. 1878. From the Author.

On *Argillornis longipennis*, from the Eocene Clay of Sheppey. By Prof. Owen, C. B., F.R.S., etc. (Abstracted from the Quar. Journ. of the Geolog. Society for February, 1878. Vol. xxiv.) 8vo, pp. 124-130. With Pl. VI. From the author.

Some Microscopical Observations of the Phonograph record. By Persifor Frazer, Jr., A.M. Also, Some Tables for the Interconversion of Metric and English Units, by the same author. (Both read before the American Philosophical Society, April 5th, 1878.) 8vo, pp. 531-538, with a table. From the author.

On the "Geodes" of the Keokuk Formation, and the Genus *Biopalla*, with some species. By Samuel J. Wallace, of Keokuk. (From the Am. Journ. of Science and Arts. Vol. xv., May, 1878.) 8vo, pp. 5. From the author.

On the Intrusive Nature of the Triassic Trap Sheets of New Jersey. By I. C. Russell. (From the Am. Journ. of Science and Arts, xv. April, 1878.) 8vo, pp. 277-280. From the author.

On the Gigantic Extinct Armadillos and their Peculiarities, with a Restoration. By Jno. A. Ryder. (From the Popular Science Monthly, June, 1878.) 8vo, pp. 139-145. From the author.

A Catalogue of the Fishes of the Fresh Waters of North America. By David S. Jordan. (Extracted from the Bulletin of the U. S. Geological and Geographical Survey. Vol. iv, No. 2. Washington, Government Printing Office, May 3, 1878.) 8vo, pp. 407-442. From the author.

Notes on a Collection of Fishes from the Rio Grande, at Brownsville, Texas. By David S. Jordan. (From the U. S. Geological and Geographical Bulletin. Vol. iv, No. 2.) Washington, May 3, 1878. 8vo, pp. 397-406. From the author.

An Account of some Insects of Unusual Interest from the Tertiary Rocks of Colorado and Wyoming. By S. H. Scudder. (From the Bulletin of the U. S. Geological and Geographical Survey. Vol. iv, No. 2.) Washington, Government Printing Office, May 3, 1878. 8vo, pp. 519-543. From the author.

Letter from the Secretary of the Interior in response to a resolution of the House of Representatives, transmitting the Report of Professor Hayden upon Geological and Geographical Surveys. With Map. (Ex. Document, No. 81, 45th Congress, 2d Session.) 8vo, pp. 22. Washington, Government Printing Office, 1878.

On the Distribution of Fresh Water Fishes of the United States. By David S. Jordan, M.D., Butler University, Indianapolis, Indiana. (From the Annals of the N. Y. Academy of Sciences. Vol. i, No. 4.) Read Dec. 4, 1876. 8vo, pp. 92-120. From the author.

Tropical Nature, and other Essays. By Alfred R. Wallace. Macmillan & Co., London. 1878. 8vo, pp. 356. Price \$3.50.

Mission Scientifique au Mexique et dans L'Amerique Centrale. Recherches Zoologiques publiées sous le direction de M. H. Milne Edwards. Troisième partie, Etudes sur les Reptiles et les Batraciens, par MM. Auguste Dumeril et Bocourt. 4to, pp. 281-360. (8 plates.) Quatrième Partie. Etudes sur les Poissons, par MM. Leon Vaillant et Bocourt. 4to, pp. 41-120. (5 plates.) Paris, Imprimerie Nationale, 1878.

Le Musée Géologique de Lausanne in 1877. Par E. Renevier, prof. (Bull. Soc. Vaud Sc. Nat. xv.) 8vo, pp. 267-272. Lausanne, 1878. From the author.

Sur la Géologie des Environs de Bex, par E. Renevier, professeur. (Ext. des Actes de la 60^e Session de la Soc. Helv. des Sc. Nat. Bex. Août 1877.) 8vo, pp. 3. From the author.

Structure Géologique du Massif du Simplon apropos du Tunnel Projeté, par E. Renevier. (From the Bulletin de Société Vaudoise des Sciences Naturelles. Vol. xv, No. 79.) Lausanne, Librairie Rouge et Dubois, 1878. 8vo, pp. 281-304. (Plates 20-21.) From the author.

Sur quelques Batraciens de Chine, par M. H. E. Sauvage. (Ext. du Bull. de la Soc. Philomathique de Paris 7^e série t 1^{er}, No. 3. 12 Mai, 1877.) 8vo, pp. 4. From the author.

Sur les écailles de ligne latérale chez Sciénoides, par M. H. E. Sauvage. (Ext. du Bull. de la Soc. Philomathique de Paris 7^e série. Juillet, 1877.) With note sur les Sparus desfontainii, etc. Par le même. 8vo, pp. 12. From the author.

Remarques sur la classification et les affinités réciproques des Chéloniens, par M. Leon Vaillant. (Ext. du Bull. Soc. Philomathique de Paris, 7^e série, t 1^{er}, No. 2. 10 Mars, 1877.) 8vo, pp. 5, planche 54. From the author.

A List of the Species of the Tribe Aphidini, Family Aphidae, found in the United States, which have been heretofore named, with descriptions of some new species. By Cyrus Thomas, Ph.D. (Ext. Bull. No. 2, Ill. State Lab. of Nat. Hist.) Printed Dec. 13, 1877. 8vo, pp. 16. From the author.

Notes on the Natural History of Fort Macon, N. C., and vicinity. (No. 4.) By Dr. Elliott Coues and Dr. H. C. Yarrow. (Ext. Proc. Acad. Nat. Sci., Phila., 1878.) 8vo, pp. 21-28. From the authors.

The Electric Constitution of our Solar System. By Jacob Ennis. (From the Proceedings of the Academy of Natural Sciences, Phila., 1878.) 8vo, pp. 19. From the author.

On the identity of certain supposed species of Sigillaria with Sigillaria lepidodendrifolia Brogniart. By Herman L. Fairchild. (From the Annals of the New York Academy of Sciences. Vol. i, No. 5.) 8vo, pp. 129-133, with a plate. From the author.

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GENERAL NOTES.
BOTANY.

THE MYCOLOGICAL FLORA OF MINNESOTA.—Dr. A. E. Johnson contributes to the Bulletin of the Minnesota Academy of Natural Sciences, an essay of a hundred pages on the fungi of that State. He has collected and determined 559 species all new to the State, two of which are new to science, and the report is the result of the examination of more than ten thousand specimens. The essay is mainly an enumeration of the species, and must prove of much assistance to local botanists, and though we are unable to pass a critical judgment on the quality of the work, it evidently reflects credit on the Society and State from which it emanates.

LIGNEOUS FLORA OF IOWA.—In a page reprinted from the *Valley Naturalist*, Prof. J. E. Todd gives a list of the trees and woody shrubs and vines of South-western Iowa, a region varying in altitude from about 1000 to 1300 feet above the sea, the prevailing soil being that of the loess.

ON THE GROWTH OF COCCULUS INDICUS.—I have noticed that the termini of the branches on a plant of *Cocculus indicus*, in the Horticultural Building in Fairmount Park, were coiled to the left about objects that came within reach. These terminal coils, which

simulated tendrils in form, would, if straightened out, measure 6 to 8 inches in length. The buds upon them appeared to be aborted or rudimentary, and as soon as the coil was securely wound round its object of support, growth in a longitudinal direction in the branch in question seemed to cease; but below the proximal part of the coil, or that nearest the root, one of the fully developed buds would break and continue the ascending axis, which, when it had attained a length of 1 or 2 feet, would coil its terminus, and stop growing lengthwise as the branch had done from which it grew. This process seemed to be repeated indefinitely. The plant might be called a *terminal twiner*. Other menispermaceous plants seemed to have a similar tendency, though not so marked, and some were not very different in habit from ordinary twiners, as, for examples, *Menispermum canadense*. *Aristolochia*, it has since been discovered, exhibits in a slight degree a similar tendency.—*Fuo. A. Ryder.*

BOTANICAL NEWS.—Francis Wolle concludes (*Bulletin* of the Torrey Botanical Club, April) that *Nostoc*, which has generally been considered a perfect plant, is not so, but the "matrix" of *Scytonema*, from which many forms of the latter genus are evolved. The paper is illustrated by a full page cut. In the *Botanical Gazette* Charles Mohr notices the foreign plants introduced into the Gulf States. Mr. R. Burgess records a case of natural radical grafting, "potting two plants of the deer's tongue and rat-tail Cactus, resulting in a profuse crop of the latter issuing from the extremity of the leaves of the former."

Trimen's *Journal of Botany* contains a notice of Rodier's second note on the spontaneous and regular movements of *Ceratophyllum demersum*. In general when examined at about six in the morning, a movement of torsion from left to right is proceeding; this then stops and gives place to a movement from right to left, which continues up to about 11 A. M., that is for about five hours; the experiments showed a mean of about 36° per hour, *i. e.*, of 180° or half the circumference during the whole time. The reverse torsion from left to right commences immediately the former ceases and goes on at the rate of about 12° an hour—one-third that of the morning; estimating its duration at $7\frac{1}{2}$ hours, its amount is 90° , or one-half that of the morning. Tables are given of these results, and show that there is by no means complete regularity in the movements.

M. Rodier's observations were stopped in November by the plant passing into its winter state, in which its movements are almost entirely suspended. The elongation of the terminal buds ceases, the last verticils of leaves remain closely imbricated, and the latter become stiffly curved, thicker, and larger, with the air-cavities swollen and full of gas, at the same time the axis becomes thickened and pink and its cells are found to be crowded with starch and rounded. In short, we have here produced winter

buds by which the plant is propagated. They are very easily detached from the old stems, and then readily float, and are carried by stream.

S. E. Cassino, Salem, Mass., announces the publication, June 10th, of *Ferns in their Homes and Ours*, by John Robinson, to be illustrated with eight chromo-lithographs of rare ferns with other illustrations.

ZOOLOGY.¹

CHANGE BY ARTIFICIAL MEANS OF A LAND TO AN AQUATIC SALAMANDER.—Some very interesting experiments have recently been made by Madame von Chauvin, regarding the change, by artificial means, in the Alpine salamander of a land to an aquatic life. From a translation of the paper in *Nature*, we take the following account, often word for word. The former success of Madame von Chauvin in inducing the development of *Amblystoma* from the Mexican axolotl by gradually accustoming it to live in air, induced her to attempt to change the habits of *Salamandra atra*. This is an ovo-viparous species, and although its young possess large gills while within the body of the mother, they are born to begin a land-life immediately, while *Salamandra maculata* brings forth its young with gills, and they live for some time in water before taking to land. The problem to be solved was whether the young of the black salamander, taken from the mother before the normal time of birth, and placed in water under favorable conditions, could become adapted to an aquatic life. Out of twenty-three larvæ of the Alpine salamander (*S. atra*) one, unlike the rest, appeared at ease when placed in water and made no attempt to get out of it, and was fed regularly. The gills, too delicate and thin for life in the water even, dropped off by the third day, but soon a second smaller set of gill-fringes grew out, which appeared to perform the work of respiration perfectly; the creature remained completely beneath the surface of the water, without ever coming up to breathe air. While the new gills were being developed the larva remained at rest as if dead, only eating the earthworms when they were offered. When the gills had attained a length of 2.2 mm., the larva became lively, and concurrent with this was the completion of another transformation. The delicate and transparent swimming membrane of the tail was lost, and replaced by a less transparent and stouter one, of greater dimensions. Finally, after six weeks' residence in the water, the skin began to be shed. Fourteen weeks after having been placed in the water, when six centimetres long, the gills began to shrink, and the tail to assume a rounder form, and in three days the skin was shed, revealing the normal black and wrinkled skin of the land salamander. At last it crawled out of the water, and on the

¹ The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A.

fourteenth day the gills were completely absorbed and the gill-clefts absorbed. The remaining larger larvæ of this experiment lost their primary gills less satisfactorily and in a greater length of time. New gills began to bud, but the animals were gradually destroyed by fungus-growths attacking various parts of their skin. The fact that they were altogether more advanced in their metamorphosis rendered them unable to adapt themselves quickly to their new conditions. Similar experiments were less successful the next year, none adapting themselves to an aquatic life. It was thought from these experiments that the spotted and Alpine salamanders were at no very distant period of time one species, and that as physical conditions became changed one variety became more and more adapted to more elevated and rocky regions, where water for the early life of the larvæ was not commonly to be met with. Thus gradually the birth of the young was postponed, and they became terrestrial; concurrently fewer and fewer of the many eggs were developed. The spotted salamander, meanwhile, became more and more specialized to inhabit the lowland district. The bearings of these facts on evolution are of much pertinence.

RIDGWAY'S ORNITHOLOGY OF THE FORTIETH PARALLEL.—The ornithology, by Mr. R. Ridgway, of the route explored by the U. S. Geological Explorations of the Fortieth Parallel, Clarence King in charge, has been lately published. The region investigated lies between Sacramento, Cal., and Salt Lake City, and the work is based on field work from June, 1867, to August, 1869, inclusive; 769 skins and 753 nests and eggs having been collected. This is in fact a work on the avifauna of the Great Basin, and the subject is discussed under four subdivisions: arboreal, terrestrial, mural and aquatic avifauna. Although the Great Basin forms a "natural province of the western region," Mr. Ridgway states that the Sierra Nevada and main Rocky Mountain Range form "much less of an actual barrier to the distributions of the species than might be supposed," and he thinks that the deserts check the distribution of the species. The author shows that Western birds "have a tendency to extend eastward during their fall migrations, thus spreading over the whole of the Western Region at this season, though in summer their habitat may be confined strictly to the area of Pacific coast drainage." He also discovered that several species supposed to be peculiarly eastern, really inhabit the entire breadth of the continent. The work is a store-house of novel discoveries regarding the distribution and habits of the birds of the Central Province of the United States, and of a high degree of interest and value at this time, though tardily published by Government. It forms Part III. Ornithology, of vol. iv. of King's Geological Explorations of the Fortieth Parallel, lately (1877) issued by the War Department.

A TWO-HEADED SNAKE.—On page 264 of your journal for April I notice an account of a two-headed snake—*Pityophis* sp., and as I have recently discovered one in the reserve series of reptiles of the National Museum of the Smithsonian Institution, I venture to forward a description trusting it may possess some little interest to your readers.

This specimen, No. 7276 Smith. Coll., was presented by Miss Marshall, of Port Tobacco, Md., and is the specimen known as *Ophibolus getulus* (Linn.) Cope, the common chain or king snake. It has two perfect heads, both possessing the scale formula which characterize the species. The length of the specimen from the extremity of the right head to the end of the tail is 9 7-10 inches, length from extremity of left head to tip of tail 10 inches, by which it will be seen that a slight difference exists. The left head and neck and continuation although somewhat smaller than the right, appears to be the snake proper, the right a sort of graft on the main trunk. The two heads are 11-16 of an inch apart and $\frac{1}{2}$ an inch from the end of each nose a fold of skin commences on the inner side of each neck, this being on a level with the commissure of the mouth. The color of the two white rings on each head posterior to the occipital plates, which are normal, are produced across this fold of skin, and a second white ring on the left head also passes down to the fold. This extends backwards $\frac{5}{16}$ ths of an inch from its anterior border and then the two spinal columns are welded together. The two oesophagi terminate in a common one a little posterior to the line of union. In all other respects the specimen is a typical *O. getulus*. The scutellæ below and behind the fold of skin run directly across both necks and bodies, no median line separating them, but become normal a little posterior to the juncture of the heads. When the two heads are compressed laterally together, the left one is found to be slightly longer than the right, which is a trifle larger. There are two white rings on each neck, the posterior one on the right a little behind the corresponding one on the left. This is the only two-headed snake in the enormously large collection of reptiles in the Smithsonian Institution, which I have lately gone over.—H. C. Yarrow, Smithsonian Institution, Washington, D. C., April 3, 1878.

NOTES ON THREE RARE BIRDS OF MINNESOTA.—Within the last few years ornithologists in and about Minneapolis, Minnesota, have found three species of birds conceded to be among the least familiar forms of our American feathered population.

One of these is the Bohemian Chatterer, or Northern Waxwing (*Ampelis garrulus*). For the past five years at least, this bird has been a regular winter resident here, arriving early in December and taking its departure in March. It is rarely observed except in large flocks, which are almost incessantly astir.

The food of the species in this latitude consists for the most part of berries, especially the fruit of the well-known snowberry bush, although it is frequently seen feeding upon bread crumbs, apple-parings and similar kinds of kitchen refuse. It is also remarked in early spring to regale itself on certain coleopterous insects which then begin to show themselves, capturing them on the wing somewhat after the manner of the true fly-catchers.

Few birds carry themselves more fearlessly among the scenes of civilization than this one, notwithstanding that its career is mainly recluse. In Minneapolis it frequently appears in the gardens and dooryards even in the very heart of the town; and with the marked beauty of its plumage and briskness of its ways, receives no little complimentary notice.

Occasionally one finds this bird caged in Minnesota, as in our severe winter weather it is readily taken in a common quail trap baited with apple. The species is, however, but poorly adapted to a life of captivity, as while it partakes regularly enough of food under these circumstances, loss of exercise ere long impairs its assimilative powers, and it succumbs to fatal emaciation. Although christened *garrulus*, the title seems a great misnomer as applied to this species, or at all events as it occurs in Minnesota; for while the species is known to very many observers hereabouts, few of these have any knowledge of its note.

My next note is on the evening grosbeak (*Hesperiphona vespertina*). Like the preceding this straggler has for the last half decade taken up his winter quarters in Minneapolis and its vicinity with almost unbroken regularity.

This also proves to be a gregarious species, seldom being seen save in troops, sometimes comprising several scores of individuals. Its usual haunts hereabouts are groves of sugar maple, the buds of which, together with the kernels of the seed of the box-elder, constitute almost its only food. It is observed with us to be even less suspicious of man than the chatterer; as it unhesitatingly establishes itself in the town shade trees, and on rare occasions, as if from motives of pure curiosity, it is seen to ramble over the housetop and up and down the porch after the manner of the wren. From its strangely ejaculatory as well as harshly piping quality, the song of the species can scarcely be compared with bird-music as one commonly understands the term. Yet notwithstanding its demerits, much of the bird's leisure time is spent in its practice both as a soloist and chorister.

The collector adds to his store the skins of the fully developed males of this Grosbeak with signal satisfaction; as from the sharply contrasted disposition of their leading hues—white, yellow and black—it is questionable whether the uniform of any of our native birds is on the whole more striking. In looking over the skins of the females taken hereabouts, they mostly disclose a

whitish edging on the inner webs of the tail feathers to which the standard authorities fail to refer.

The third bird on my list is LeConte's bunting (*Coturniculus Lecontei*). The discovery that this little known species is to be included among the birds of Minneapolis is the latest ornithological novelty of which the district can boast; being first indisputably noted only during the past summer. But his presence is still far from being a familiar one in this part of our territory, as up to date he has rigidly confined himself to one particular spot. This is a large tract of meadow just outside the city limits, which, despite the close proximity of a railroad and several other scarcely less noisy highways, proves to be a great resort for many birds, among them the species in question. It has been observed on sundry occasions during the last season, and taken both in juvenile and adult stages.

One of the smallest of the sparrows, and likewise one of the least noticeable in point of attire, it is also the fate of this species to lead a career of the utmost unobtrusiveness and humility; being for the most of his time buried deeply in the grass, where he gleans the lesser grubs and more delicate seeds found to constitute his fare. In his style of flight, as well as in his song, he is almost undistinguishable from his yellow-winged brother sparrow (*Coturniculus passerinus*); in short, it may be described as the yellow-winged sparrow transferred to low grounds and marked by certain constant characteristics brought about by the change.

While the young of the bird were procured in several instances in the meadow to which I have alluded, the nest remained undetected, doubtless being hidden so securely in the grass that its whereabouts could only have been brought to light by the luckiest chance.—*W. L. Tiffany, Minneapolis, Minn.*¹

MODE OF DISTRIBUTION OF FRESH-WATER MUSSELS.—On April 17, 1877, the writer, while exploring that portion of the Erie Canal known as the Wide Water, near Mohawk, N. Y., unexpectedly came across *Unio rubiginosus* Lea. Five specimens in all were secured during this and two succeeding expeditions. The species has not hitherto been found on the Atlantic slope, but belongs to the Ohio basin, and, hence, to the western fauna. It has been recorded at Buffalo (*teste* Prof. C. Dewey), and at Rochester (*teste* C. T. Robinson) in Western New York, but only in streams flowing into the great Lakes. Between Mohawk and the latter localities is a ridge or water-shed sloping to the West and the East. The Erie canal passes over this ridge, and through it the species has probably been introduced and colonized. My friend, Dr. Lewis, of Mohawk, informs me that about eight years ago he found in the canal, a single specimen of *Unio gibbosus*

¹ The nest and eggs of *C. Lecontei* are unknown, and Mr. Tiffany would do well to make thorough search for them on the spot where the species thus unexpectedly proves to be abundant.—*E. C.*

Barnes. Through the same medium other western species may be introduced.

Unio pressus Lea, was also found by the writer, near the same locality (within three miles) in May, 1877, but under conditions that preclude the possibility of its introduction in a like manner. Two specimens were taken from a small lake near Herkimer, N. Y. The lake lies between high hills and receives as its water-supply an artificial branch of West Canada Creek, a mountain stream having no connection with the Erie canal, or any stream that could possibly reach it from the west or south. It empties into the Mohawk, but over a very rocky bed, and after a considerable fall. The species is essentially western, but is recorded at Troy, N. Y. (Vide Lewis in Bulletin Buf. Soc. Nat. Sci. Aug. 1874, p. 127). Its occurrence in the latter locality may be explained, perhaps, in a manner similar to the preceding, though at no known intermediate localities has it been found. The problem to be solved is: How came this western species in this isolated eastern lake? Mr. Darwin, (in "Origin of Species," p. 344, Ed. 1877) has conjectured a probable mode of distribution, relating particularly to certain fresh-water univalves. What Mr. Darwin conjectured the writer has actually seen. The same may occur with bivalves, and certainly does. Mr. Arthur F. Gray, of Danversport, Mass., has informed me of the foot of a water-fowl, now in his possession, to which is attached a bivalve shell, the former caught and firmly held by the latter.

The young of Uniones, since they are capable of swimming freely about, may be distributed in the manner suggested by Mr. Darwin; viz: attaching themselves to pond-weeds, the latter being often carried away by water-fowl. That *Linnaea* and *Planorbis* do thus attach themselves every collector knows. Whatever the manner or cause of its introduction *Unio pressus* is found in the above lake, absolutely foreign to any stream through which the species might have been introduced. This species, as well as the preceding, may yet become colonized in the Mohawk River. The fact of its occurrence now and its probable recent introduction in the locality mentioned, under conditions that seem physically impossible, may be of interest when the geographical distribution of the Unionidae comes to be more fully studied.—R. Ellsworth Call.

DEFENSIVE URINATION OF THE FROG.—On the Iowa prairies, often a mile from any water, one frequently meets with frogs which leap out of the way in a very startled manner. Generally, as the first leap is made, the frog ejects a quantity of water, which falls in a mass to the amount of a fluid ounce or more, with a largely diminished quantity the second time he springs from the ground. The idea which naturally occurs to the observer, is, that this water is the ordinary urine of the reptile, voided in this

manner in consequence of the muscular action occasioned by his sudden fright. But I once saw a common garter or striped snake spring suddenly after a frog in an attempt to seize him. These snakes are reasonably active when they proceed in the ordinary style; but when they are attempting to seize their prey their motions are so quick that the eye must be very intent to follow them. In this case the frog was just a hair's breadth of time too quick for the snake, making a high and vigorous leap forward. As he sprang the usual evacuation of water fell from him, striking the snake fairly on the head, and most probably filling its open mouth. One or two more leaps in instantaneous succession carried the frog out of danger, and he was not made a meal of. But the snake was evidently blinded by the urinary discharge, for he wriggled and twisted, sprang wildly around from side to side, and was completely thrown off the track of his game. My sympathies were with the frog, and I thought in regard to that obfuscated snake, "served him right." The incident was, of course, an amusing one, and thinking of it afterwards, it occurred to me that this habit of the frog might very properly be classed as a defensive one. The snake is its usual, most frequent and most relentless enemy. Having glided noiselessly through the grass it finally makes a spring for its victim in precisely such a way as to be enveloped in this discharge, should it fail to seize the frog. The snake has no "winkers" to its eyes, and of course cannot quickly correct the blinding effect which even pure water suddenly dashed upon its head would necessarily produce. The light must be variously refracted, and images falling upon the retina very badly mixed up and distorted. In the "noise and confusion" thus arising, the frog makes good his escape. While the secretion and discharge of the urine is an ordinary physiological process, its use in this manner may be none the less a means of defense. The force of the ejection, doubled by the action of the snake in nimbly darting from the opposite direction, the amount ejected and the circumstances attending the act, all seem to justify the inference that this, aside from concealment in the green herbage, is about the sole means of defense provided—"developed"—by nature to aid the harmless and inoffensive frog in evading the clutch of its alert and nimble enemy.—*Chas. Aldrich, Webster City, Iowa.*

REMARKS UPON ALBINISM IN SEVERAL OF OUR BIRDS.—During the autumn of 1876, I saw a pet crow (*Corvus americanus*) bearing rather strange markings of a grayish color over the rump, sides and abdomen, as well as about one-half of the tail feathers. Upon the approach of winter the bird accidentally had the tail pulled out; when about two months later, it was replaced by feathers of a pale gray tint. During the coming moulting season, the parts which had previously been of a grayish color, now became white, and in addition several quills in both wings. I

became the possessor of the specimen and kept it for several months, when the bird grew sick and died. The disease affected the skin and feathers to such an extent that it was unfit for preparation; although the specimen was for some time a matter of public curiosity. An instance of total albinism occurred some years ago in Lehigh County, Penna., where the bird was kept for a number of years as a bar-room pet. Another example occurred during the winter of 1873-74, in Montgomery County, Penn., where the specimen was secured while a hunting party happened upon a rookery during the night. A great many birds were shot and amongst them the albino.

Several instances of total and partial albinism in *Turdus migratorius*, have come under my observation in Pennsylvania. In several of the supposed cases of total albinism, a pale yellowish tint could be discovered upon the tips of the feathers over the breast and sides, which was replaced upon the back by a slight grayish or ashy shade; although at a short distance they appeared perfectly white.

A female *Hirundo horreorum* was secured in the summer of 1875, near Reading, Penna., which had patches of white upon either side, extending upwards and forwards to the base of the wing. The left wing also contained several white secondaries.

From the spring of 1874, to the summer of 1877, four different specimens of *Passer domesticus* have come under my observation which were partly white. The markings were irregular and included parts of the wings, rump and abdomen, or as in one instance, the tail feathers. One specimen of total albinism was seen in the streets of Reading for several months, when all of a sudden it disappeared from its usual haunts, no doubt being secured by a collector for the adornment of his cabinet.

There is at present in a collection in Reading, an example of a nearly white *Buteo borealis*. The only defect consists of pale yellowish brown transverse markings near the tip of the tail feathers. There are visible upon close examination, delicate ashy tinted median lines in the feathers of the head, neck and back. In all other respects the bird is certainly interesting.

Partial albinism in *Agelaius phoeniceus* is not of uncommon occurrence, when one is on the lookout for such specimens. In the collection before referred to, are several males with the deep red and yellow colors upon the wings, but which in other respects appear very different. The color at a short distance appears yellowish-brown, which upon closer inspection, results from that color tipping all the feathers over the body. In another specimen, the red of the wing is replaced by deep orange.

Frequent specimens of *Sturnella magna* occur which would readily be taken for *neglecta*, were the observer ignorant of the locality. They resemble the latter very closely, but do not have the characteristic note of the western variety. There are more

than half a dozen specimens in the aforesaid collection, all having similar markings and shade.

In addition to the above, *Calamospiza bicolor* frequently varies. Odd white feathers are scattered indiscriminately over the neck or breast, as was noticed in a number of specimens secured on Heart River, Dakota Territory. One specimen in my collection, has but a single white feather on the throat, though that appears rather prominently upon the black back ground.—*W. F. Hoffman, M.D.*

MODE OF MOULTING OF THE LINING OF CROP AND STOMACH IN INSECTS.—Attention has been lately directed to the mode of moulting by German zoölogists, especially from the histological stand-point, with interesting results. Dr. Braun has published an article on the histological occurrences in the moulting of *Astacus fluviatilis* in Semper's Arbeiten (ii. p. 120, 1875). In the same Journal and volume Cartier gives the results of his studies on the finer structure of the skin of reptiles, Kerbert has recorded his observations on the skin of reptiles and other vertebrates in Schultze's Archiv für Microscopische Anatomie (xiii), and, during the past year, Dr. Wilde has made known his observations on the mode of moulting in the grasshoppers and locusts (Wiegmann's Archiv).

In the reptiles as well as in the craw-fish (*Astacus*), moulting is effected by the growth of fine cuticular hairs of temporary growth which originate on the new skin, and grow up, thus loosening and pushing off the old skin. When this is accomplished these deciduous hairs disappear. This has been observed in the reptiles as well as in *Astacus*. Exceptions to this rule only occur in the reptiles on certain parts of the body, as for example the under side of the scales, the capsular skin of the eyes; in the crawfish the faceted cornea of the eye, the eyestalk itself, and the inner lamellæ of the fold of the carapace over the gill-openings.

It has probably been noticed by many that in moulting, the crayfish and lobsters cast off the solid chitinous lining of the crop and fore-stomach (proventriculus) the large teeth lining the latter remaining within the cast skin. It is so with the chitinous, teeth-bearing lining of the crop and fore-stomach of insects.

Dr. Wilde maintains that the moult of the crop and proventriculus (fore-stomach) follows that of the integument, and according to Braun the formation of a new cuticle in the stomach of the crayfish results at rather a late period after the change of skin. In the Orthoptera (grasshoppers and locusts) as soon as the moulting has taken place, the old cuticula of the crop and fore-stomach has disappeared. Wilde found that in several species, when about to moult, in all cases the old chitinous layer of the crop and fore-stomach was separated from its under layer, a new cuticula already being present. If we cut open the crop longitudinally

inally we can remove the old cuticle without difficulty, a proof that it is cast off *in toto*.

Braun has maintained that the solid hairs and their modifications in the crop and fore stomach of the crawfish, are comparable with the cuticular hairs of the same animals; i. e. are merely for ornamentation, but Wilde considers that the homologous spiny hairs in the crop of the Orthoptera triturate the food (their function is, however, evidently to prevent the food from regurgitating into the mouth, together with the peristaltic action of the crop and digestive canal). That these hairs lining the crop and fore-stomach are useful in throwing off the old cuticle is plain, but this is only a purely secondary use. Wilde says he has observed the process of moulting in *Locusta viridissima*, *Decticus verrucivorus* and *Gryllus campestris* in the clearest manner, favored in part by the peculiar inner structure of the crop in the last. All the hairs and hair-like growths in the crop and proventriculus of the Orthoptera, take their origin not from cell-tubes, as is mostly the case in *Astacus*, but they are in the Orthoptera much more solid, and originate like spines on the chitine cells, like the projections on the flame-like cells (flammenzellen) of the walrus, as observed by F. E. Schulze. In no case is the moulting, in Orthoptera, performed as in *Astacus* and the reptiles, where two or three solid bristles are developed in a cell, by which the old cuticle is loosened. In the Orthoptera it rises simultaneously throughout its extent, so that the new cuticle rising under it, whether in the form of hairs or flattened, hairless chitinous growth, elevates the old cuticle as it keeps on growing (Fig. 23). As soon as the old cuticle is stripped off, the new cuticle completely formed is to be seen under it. It is, indeed, completely hyaline, and reminds one of the cuticle in the orthopterous larva, just after exclusion from the egg. Yet it takes on, after a few days, probably through the influence of the air, which passes through very fine tracheal twigs under the layer of epithelium, the characteristic yellow-brown color of the chitine. The secretion of the new cuticle must proceed with great rapidity. It does not take more than one, or at least two days to develop. Wilde does not state how the cast chitinous lining of the crop and proventriculus passes out of the narrow cesophagus and pharynx.

ORNITHOLOGICAL NOTES.—The habit of laying in other birds' nests is a well-known peculiarity of the cow-blackbird (*Molothrus pecoris* Sw). It seldom happens, however, that the intruder is successful in depositing more than one egg in a nest, yet I found a grass-finch's nest last summer which contained five eggs, three of which had been laid by the cow-bird. On the plains of Colorado I have frequently found single eggs of the latter deposited on the bare ground, and this fact was accounted for by the absence of timber in which birds might find suitable conditions for nidification. In one day I picked up *two* eggs of the cow-

bird at widely separated points, and an examination discovered them to have been recently laid. In the absence of the nests of other birds, therefore, the cow-bird will drop its eggs indiscriminately in times of sudden or unexpected delivery.

I met also, a few years ago, with a singular case of the ovipositing (or reproductive parasitism, I could not determine satisfactorily which) of the meadow-lark (*Sturnella magna* Bd.), in some degree analogous to that of the yellow-billed cuckoo. One nest which I found near Parkesburg, Penna., contained five eggs which had been laid at two distinctly separated periods, and, to all appearances, by two different individuals. Three of the eggs were smaller than the ordinary eggs of this bird and were so far advanced in the stages of incubation that I found it impossible to remove the contents without destroying the shells. The remaining two, however, were much larger and perfectly fresh. There was no doubt, however, that all were of the same species.—*E. A. Barber.*

ANTHROPOLOGY.¹

ON THE PROBABLE USE OF DISCOIDAL STONES.—There is one class of pre-historic relics which has been treated or referred to by nearly every writer upon archæology, with nearly as many theories and conjectures as to the probable use. Schliemann devotes many pages to illustrations, most of the specimens bearing exquisite designs in ornamentation. England, Ireland and several continental localities have yielded numerous examples of the same style of relics with less ornamentation. The mounds throughout the Ohio and Mississippi valleys have furnished many highly wrought specimens, but rarely any with any attempt at ornamentation. These relics occur of various materials, such as diorite, syenite, quartzite, novaculite, greenstone, jasper, and in a few cases catlinite. They are circular, concave on either side sometimes, and I might say generally have a hole in the middle, varying from one-eighth to one-fourth of the total diameter. The periphery is seldom flattened but usually slightly convex, showing no trace of wear, but on the contrary, perhaps more highly polished, if that be possible, in many of those found.

There are two predominating sizes; specimens of the first class averaging from three to six inches in diameter, while those of the second are generally less than two inches. These may again be subdivided according to their perforation, ornamentation, etc., but it is not our purpose to dwell upon these points. The smaller specimens, which are found to exceed the larger in great proportion, were no doubt used in games, similar to tossing pennies and winning upon certain pre-arranged agreements. There may have been some colors used to distinguish one side from the other, and as colors, manufactured and applied by aboriginal races are easily removed, we can readily account for their absence

¹ Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

after years of exposure or burial. Many of our American tribes play games in which four, five, or even six small bodies are employed, upon one or both sides of which lines or other characters are cut or burned to serve the purpose of ready identification. The Dakotas make beautiful specimens from the seeds of *Prunus virginianus*, upon which lines are burned so as to give the stone the appearance of a beetle.

These stone relics were not employed in hunting, by throwing at birds or game, as some have ventured to suggest, as the time and labor employed in their manufacture would have been more than lost. I doubt if any were suspended as ornaments or charms, as the constant wearing of a cord would eventually leave its impression upon the sharp edges, and then for a warrior to be impeded by any weighty and unnecessary ornaments is inconsistent with aboriginal customs. A disk made of catlinite, measuring about three inches in diameter, was recently found among a sub-tribe of Utes in south-western Colorado. The specimen is little more than half an inch thick, having a perforation in the centre around which are cut a series of narrow circles extending nearly to the outer edge. The opposite side is perfectly smooth. As this was used in gaming, by tossing into the air and betting upon the side to turn up, we are led to suppose that similar relics were used by other tribes for similar purposes. That the relics of the mound-builders are of much superior workmanship is granted. None of the implements of the modern Red race will compare with them, therefore we can scarcely expect to find any relics of this class in as good condition, or as perfectly finished.

The larger discoids were used for another style of amusement. The materials employed in their manufacture are usually of the hardest species of stones or rocks, as they were in greater danger of being broken. These larger discoidal stones were undoubtedly used in playing what is now termed the *chunge* or *tehunge* game. To illustrate my reason for the supposition I shall submit some remarks and references from a recent report made to Prof. F. V. Hayden.¹ Catlin² gives a description of the *tehunge-kee* game as one of the amusements of the Mandans. This was played with a stone ring two or three inches in diameter. Prince Maximilian³ also noticed this among the Mandans and Manitaris (Minnetares). The Abbé Em. Domenech⁴ describes a game of this character as observed in the extreme western portion of the continent. Adair⁵ describes the national game of the Cherokees under the

¹ Miscellaneous ethnographic observations on Indians inhabiting Nevada, California and Arizona. W. J. Hoffman. U. S. Geolog. and Geog. Survey of the Territories. 1876. pp. 461-478.

² Illus. of the Manners, Customs and Conditions of the N. American Indians, etc. 10th edition. Vol. i, p. 132, pl. 59. London. 1865.

³ Travels in the interior of North America. London, 1843, p. 358.

⁴ Seven years residence in the Great Deserts of North America. Vol. ii, p. 197. London. 1860.

⁵ Hist. of Am. Indians, etc. Page 401 et seq. London. 1775.

name of *chungke*, and gives a detailed description. Jones¹ says, "The great game upon which the Southern Indians stake both personal reputation and property was the *chungke game*." For further reference to this game, and the tribes by whom it was played, I would refer the reader to works by DuPratz,² Brackenridge,³ Lewis and Clark,⁴ Turner,⁵ Morgan⁶ and Prickett.⁷ I saw a game of this sort played by the Coyotèro Apachès, which will be described farther on. As far as I am able to learn, it is indulged in, to-day, only by this tribe. The Cuchanos (Yumas) played a game of this kind until recently; which they called *mo-upp*, the Mexicans termed it *redondo*.⁸ Lieut. Whipple⁹ in speaking of the Mojaves says, "Some of the young men selected a level spot, forty paces in length, for a play ground, and amused themselves in their favorite sport with hoop and poles. The hoop is six inches in diameter, made of an elastic cord. The poles are straight and about fifteen feet in length. Rolling the hoop from one end of the course, two persons chase it half way, and at the same instant throw their poles. He who succeeds in piercing the hoop wins the game."

As far as I was able in ascertaining, this game was not played by the Mojaves in the immediate vicinity of Camp Mojave (A. T.) in 1871, at which time I had occasion to visit that locality in a scientific capacity.

Since enterprising traders and settlers have established themselves at or near all the Indian reservations in the country, the aborigines have almost entirely discontinued the manufacture of implements and weapons of stone, substituting such articles as can be purchased to answer the requirements of the game. Thus instead of spending days of patience and labor on a stone ring or discoid, one can be constructed of twisted raw-hide or wood in a few hours, which answers the purpose as well or even better.

The Coyotèros above mentioned play a game similar to that of the Mojaves, corresponding in all particulars also to the so-called *chung-kee* game. A perfectly level piece of ground is selected, which is afterward retained for this game only. A distance of about twenty-five paces is marked off, having a width of about four feet. Two play the game, and the necessary materials required are a pole for each of the players, and a hoop made of a

¹ Antiq. of the Southern Indians. 1873, p. 96.

² Hist. of Louisiana. 1720. p. 366.

³ Views of Louisiana, p. 255, 256.

⁴ Lewis and Clark (by Paul Allen). Philadelphia. 1814. Vol. i, p. 143.

⁵ Traits of Indian Character. Vol. ii, 1836, p. 168. [Extracted (in substance) from Halliday Jackson's "Civilization of the Indians."]

⁶ Third Ann. Rep. of the Regents of the Univ. of N. Y., 1850. p. 81.

⁷ History of Alabama, etc. Charleston. 1851. Vol. i, pp. 141-143.

⁸ Emory's Report. U. S. Mex. Bound. Sur. Vol. i, p. 111. See also "Bartram's Travels in N. and S. Carolina," etc. Philadelphia: 1791. London (2 vols.): 1794. Paris (2 vols.) an vii.

⁹ Pac. R. R. Rep. Vol. iii, 1856, p. 114.

branch of tough wood nearly an inch thick, which is formed into a ring having a diameter of about six or seven inches. This is sometimes wrapped with raw hide or sinew. Then there are two cords running horizontally across the inner space, intersecting two similar ones attached vertically, giving the middle the appearance of the cross-wires in an engineer's transit. The poles are each about fifteen feet long, consisting of spliced pieces of cottonwood, and having the general appearance of a good sized fishing rod with the thin end slightly turned upward. When the players are ready, they take their positions at one end of the course, and one of them placing his forefinger on the periphery of the hoop and grasping the sides with his thumb and fingers, rolls it with sufficient force to drive it to the other end of the course. When it is half way the players start abreast, pushing their poles on the ground before them. When they reach the middle of the course the poles are pushed ahead so as to pass through one of the spaces between the cords, the game resulting upon some previous agreement as to what was required in counting. This is repeated from the end where the first attempt terminated, and continued for hours. I have seen men lose blankets, horses, bows and arrows, and in fact almost everything of which they were possessors.

Similarities between this and closely allied games formerly practiced might be noticed, but it is not the object of the writer to more than refer to the probable use of the discoids as mentioned in the beginning.—*W. F. Hoffman, M.D.*

TRIBES OF CALIFORNIA, BY STEPHEN POWERS.—In the May number of the *NATURALIST* attention was called by a brief note to the third volume of contributions to North American Ethnology, edited by Major J. W. Powell, and especially to the portion of it written by Mr. Stephen Powers. The great merit of Mr. Powers' work demands for it a more extended notice. In addition to acute powers of observation, great tact in dealing with the Indians, and a genuine sympathy, the author enjoyed during a portion of his three years the official recognition of the Interior Department and of the Smithsonian Institution. He speaks, therefore, as one having authority. Taking Herbert Spencer's descriptive sociology as a guide in estimating the exhaustiveness of any ethnographic work, we commence necessarily with Mr. Powers' account of the environment of the California Indians. On this point the author is extremely lucid and exhaustive, seizing as if by intuition the relation of the people to the land, and expressing it in language exceedingly terse and attractive. The reader will be especially charmed with those sentences in which the winds, the sky, the storm, and the darkness are brought into relation with savage life and feelings. The tone of sadness with which the great depletion of former populations under the blighting effect of the worst element of our civilization is narrated, is thought by some to be gratuitous; but Mr. Powers in his letter to Major Powell

(with a generosity as rare as it is refreshing, quoted in full in the opening address to the Secretary of the Interior) remarks characteristically, "If any critic, sitting in his comfortable parlor in New York, and reading about the sparse aboriginal populations of the cold forests of the Atlantic States, can overthrow my conclusions with a dash of his pen, what is the use of the book at all?"

Upon the next point, the physical characters of the California Indians, the work of Mr. Powers will be unsatisfactory. As to external characteristics, stature, color, &c., he is sufficiently explicit, and frequently quite original in his method of description; but the comparative anthropologist demands more than this now. The volumes of instructions issued by the Société d'Anthropologie, by the Anthropological Institute, by the German government to the merchant marine, by the Austrian government, and by other anthropological societies, attest the anxiety of leading savants to reduce every investigation to absolute measurement. With reference to the psychological characteristics of the various tribes, Mr. Powers is more explicit; indeed the author is again at home and leaves nothing to be desired as he lays bare, in order, the good and the bad that are in the Indians whom he is describing. This discriminating power is well illustrated by a remark of Mr. Powers concerning the Wintun, p. 229. "With that toughness and tenacity of life characterizing some of the lower order of beings, they have lived on and possess their homes while better and braver races have gone to oblivion."

In the culture-historical portion of the work, the author is decidedly in his proper element. Nothing has escaped his eye. As he proceeds from tribe to tribe, we have recorded for us every article of diet and drink throughout the year, and all the herbs that enter into their pharmacopœia; the size and shape, the material, and the mode of construction of their dwellings, together with their furniture, vessels, and appurtenances; the style of dress of both sexes, and of all ages, classes, and occasions; their implements of every craft with the manner of using them; their games and pastimes, especially their gambling, of which they are passionately fond; their music, over which the author grows, once at least, quite sentimental, p. 212; their domestic life in the marriage relation and in the management of children, including the discussion of prostitution and adultery, and the curse of infanticide; their social system and customs, together with their governmental organization and administration; last of all their religion, which has no "idea of the 'Great Spirit,' for these people are realistic and seek to personify everything," nor of "happy hunting grounds," for the indolent Californian, reared in his balmy clime knows nothing of the fierce joy of the Dakota hunter, but believes in a heaven of "hedonic ease and luxury." A valuable addition to the work is the collection of vocabularies made principally by Mr. Powers and Mr. George Gibbs and collated in the appendix.

The remarks of Mr. Powers upon these dialects, both in the introduction and throughout the volume add greatly to the value of this linguistic material. The following table will give some idea of the contents of the work and of the accompanying vocabularies.

LINGUISTIC STOCKS :

	Chapters VI.—IX., XI., XIII.	Vocabularies	page	
1 Tinneh.	" IV. and V.	"	460.	
2 Yurok.	" I., II., III.	"	447.	
3 Karok.	No description.	"	474.	
4 Chimariko.	Chapters X. and XI.	"	478.	
5 Wishosk.	" XIV., XV. and XXI.	"	483.	
6 Yuki.	" XVI.—XX. and XXII.	"	491.	
7 Pomo.	" XXIII.—XXV.	"	518.	
8 Wintun.	" XXVI.	"	607.	
9 Shasta.	" XXVII.	"	none.	
10 Modok.	" XXVIII.	"	601.	
11 Achomawi.	" XXX.—XXXII.	"	586.	
12 Maidu.	" XXXIII.	"	536.	
13 Mutsan.	" XXXV.	"	570.	
14 Yokuts.	No description.	"	568.	
15 San Antonio.	" "	"	560.	
16 Santa Barbara.	Located on Linguistic Map.			
17 Washo.	" " "			
18 Shoshoni.	" " "			
19 Yuma.	" " "			

Accompanying the volume is an excellent colored map prepared under the immediate supervision of Major Powell, and locating each of the nineteen stocks as nearly as it can be done, considering the fickleness and migratory habits of the Indians and the crowding of the white settlers.

ANTHROPOLOGICAL NEWS.—On the 5th of April, Mr. Albert S. Gatschet read a paper before the American Philosophical Society on the "Timucua Language," formerly spoken in the eastern part of Florida as far south as Tampa Bay. The paper is based upon the works of Padre F. Pareja, in the Library of the N. Y. Historical Society. In one of the volumes Mr. Gatschet found a loose sheet of paper on which a Mexican had carefully transcribed the Lord's Prayer from a volume entitled "Explicacion de la 'Doctrina' que compuso el Cardinal Belarmino por mandado del Señor Papa Clemente VIII. Traduida en lengua Florida por el Padre Fr. Gerorio Muoilla, &c., &c., Mexico, 1635."

No. 318 of the Smithsonian Publications is an illustrated quarto brochure of 35 pages and 10 plates, entitled "On the Remains of Later Prehistoric Man obtained from the caves in the Catherina Archipelago, Alaska Territory, and especially from the caves of the Aleutian Islands," by W. H. Dall. In the first part of the paper the author calls attention to the differences between the Kaniag'muts, or typical Eskimo tribes, and the Aleüts, or Aleutian Islanders. He then refers to the burial customs of the latter, especially at the time of their first discovery by the Russians. The chief attraction of the contribution is the illustrated description of the collection of mummies or desiccated bodies from a

cave in the island of Kagamil, one of the group known as the Islands of the Four Mountains, or Four Craters. These mummies were deposited in the National Museum in 1874, and quite extended notices were published at the time; but Mr. Dall's publication has brought the information into a permanent form. The heliotype plates are beautifully executed and greatly help the understanding of the text.

It gives us great pleasure to welcome the first number of *The American Antiquarian*: A Quarterly Journal devoted to Early American History, Ethnology and Archaeology. Edited by the Rev. Stephen D. Peet, and published by Brooks, Schinkel & Co., Cleveland, Ohio. The leading article is upon Ancient Garden Beds of Michigan, by Bela Hubbard, illustrated by four plates, which the binder has carelessly inserted in the wrong order. The article of next importance is by the editor, upon the Discovery of the Ohio: Early Maps of the Great West. The other articles, which our space does not allow us to particularize, are all valuable materials to be worked up eventually into a comprehensive work on North American Archaeology.

Anales del Museo Nacional de Mexico, Entrega 3^a, contains two archaeological papers: "Un cincel de bronce de los antiguos Aztecas," Sr. D. G. Mendoza, and "Codice Mendozino: Ensayo de descrifacion geroglifica," per Señor Don Manuel Orozco y Berra.

In the February number of the *Journal of the Anthropological Institute* is a communication entitled "Customs of the New Caledonian Women belonging to the Nancaushy Tiné, or Stuart's Lake Indians, Natotin Tiné, or Babines, and Nantley Tiné, or Frazer's Lake Tribe, from Information supplied by Gavin Hamilton, Chief Factor of the Hudson's Bay Company Service. The same journal contains the report of the Anthropometric Committee, with color-plates; The Ethnology of Germany, II; The Germans of Caesar, H. H. Howorth; The Migrations of the Saxons, Part III, id.; The Croats, id.; Flint Flakes from Egypt, Capt. R. Burton; Notes on Socotra, Capt. F. M. Hunter; Australian Languages and Traditions, Rev. C. C. Greenway, Thomas Honery, Mr. McDonald, John Rowley, Dr. Creed, C. H. E. Carmichael.

Mr. Francis Galton read a paper before the London Anthropological Institute, April 30th, on composite portraits made by combining those of various persons into a single resultant figure. A good report of the method is given in *The Academy*, May 11. In the same number is a brief report of a paper by Mr. C. Staniland Wake on "The Origin of the Classificatory System of Relationships used among Primitive People." The author takes issue with Mr. Morgan's explanation of the classificatory system as having originated in the practice of marriage among consanguine.

The latest advices from Paris bring word that instead of the "Seances plénières internationales," there will be a congrès international des sciences anthropologiques, beginning June 24th, and continuing three days. The latest advices report over three hundred French exhibitors and nearly as many foreign.

By some misdirection of the subscription we have been deprived of the *Revue d'Anthropologie* for a year, but the numbers for January and April of the present year come to make amends for the loss. The January number opens with a paper by the editor upon the brain of the gorilla. The author admits that the progress of research has taken this investigation somewhat away from anthropology. "Les transformistes s'accordent généralement à reconnaître que l'homme ne peut descendre d'aucun des anthropoïdes connus, ni même d'aucun autre genre vivant." The second paper is by A. Hovelacque upon the classification of languages in anthropology. The author first examines the geographical, physiological and psychological methods and rejects them. He then seeks to divide languages by structure simply without any regard to relationship. "Two idioms may be monosyllabic, agglutinative or inflected, without having any bond of relationship. The Basque and the Japanese are both agglutinative, but their roots are entirely distinct. The natural classification of language does not accord in any way with the anthropological classifications which the present state of the science presents. Originally, language corresponded to race, that is to say certain races have given birth to linguistic systems similarly diverse, but the revolutions of time have broken up all that. The unfortunate maxim "Like race, like language," has retarded the progress of anthropology and linguistics.

The article by Dr. E. Hamy, upon the First Inhabitants of Mexico, has already been noticed in the *NATURALIST*.

In the *Revue Critique* the work of Dr. Boudin upon *Pathological Anthropology* is extensively noticed. The author endeavors to trace out the relation between race and diseases, such as pulmonary phthisis, variola, syphilis, malarial fevers, yellow fever, cholera, and the bite of serpents, and also the amount of vital resistance and the longevity of various races.

The *Revue Préhistorique* is conducted by M. G. de Mortillet, and consists of short, pointed articles upon the papers and works which have appeared in this department. The review of works and journals occupies fifty-four pages. From page 158-184 is the text in full of Dr. Broca's address before the French Association last summer upon the fossil races of Western Europe. The number closes with the Bibliographical Bulletin. The work is really the anthropologists' *vade mecum*, and it is hoped will receive the liberal patronage which it deserves.

Those interested in the relation of the phonograph to phonology will find interesting articles upon the subject in *Nature*, almost

every number containing something from such able men as Mr. A. J. Ellis, etc.

The third livraison of *Matériaux* contains the following articles of general import: *Tombeaux du temps des habitations lacustres en Suisse*, Rodé; *Huitième congrès annuel de la Société Allemande d'anthropologie*, by Graf Gundaker Wurmbrand; *L'âge de la pierre dans les souvenirs et les superstitions populaires*, E. Cartailhac; *Armes et Objets de parure des cabinets de l'Université jaguellone à Cracovie*, Ernest Chantre; *Le Musée des antiquités nationales de Saint Germain-en-Laye*, H. Mazard.

Attention is called to the following titles: An inquiry into the reputed poisonous nature of the arrows of the South-sea Islanders, by Dr. A. B. Messer, *Jour. of the Anthropol. Institute*, Feb., 1878; *The Ethnology of Germany*, Parts II and III, H. H. Howorth, id.; *Australian Languages, &c.*, several papers, id.; *Flint Flakes from Egypt*, by Capt. R. F. Burton, id.; *The Spread of the Slavs*, Part I: *The Croats*, by H. H. Howorth, id.; *Notes on Socotra*, by Capt. F. M. Hunter, id.; *The Characteristics of the Malayo-Polynesians*, by the Rev. S. J. Whitmee, id.; *Amusements of the English People*, by G. Turner, *Nineteenth Century*, Dec.; *English Folk-lore, Leisure Hour*, Jan.; *La Chronologie préhistorique, &c.*, *Révue Scientifique*, Jan. 19; *L'histoire de la civilisation et la science de la nature*, by M. DuBois Reymond, id.; *Primitive Property*, by M. Laveleye, translated by G. R. L. Marriott, and published by McMillan & Co.; *Die Verhandlungen der Berliner Gesellschaft für Anthropologie, Ethnologie, und Urgeschichte für 1877*, contains very important contributions to general anthropology; *Einige Bemerkungen über die Urgeschichte Norddeutschlands*, *Das Ausland*, No. 8, 1878; Review of Schliemann's work, id, No. 7; *Les trois premières Années de l'Enfant*, by Bernard Perez (Ballière, Paris); *The Art of prehistoric Greece*, by A. H. Sayce, *Academy*, March 2d; *Art-weaving among the Ancients*, by T. Nelson Dale, *Penn Monthly*, Feb.; *Le Khedive et L'Egypte*, by M. Van der Berg; *Révue Scientifique*, Jan. 26th; *War rites of the Zulu-Kaffirs*, *United Service Magazine*, Nov. 3d; *The Leading Religions of the World*, by Sir P. Colquhoun, a paper read before the Royal Society of Literature, Feb. 27th; *Die orientalische Frage als cultur-Frage*, by Friedrich von Hellwald, *Das Ausland* No. 5, 6 and 7; *Primitive culture of the Babylonians*, by W. St. Chad Boscawen, reviewed in *Academy*, March 9th; *Culturgeschichte des Orients unter den Chalifen*, by A. Von Kremer, reviewed in *Academy*, Feb. 2d and March 16th; *Polyandry in Northern Hindustan*, by J. Muir, *Indian Antiquary*, Nov., 1877; *Slavonians and Rajpoots*, by Sir Henry Maine, *Nineteenth Century*, Dec.; *Tableau des Progrès faits dans l'étude des langues, de l'histoire, et des traditions religieuses de l'Orient pendant les années 1875 et 1876*, by Ernest Renan, *Annales Philosophie Chrétienne*, Nov. 12th; *New Zealand and the South-*

sea Islanders, by Sir Julius Vogel, London Colonial Institute.—*Otis T. Mason, Washington, D. C.*

The publishers of the *NATURALIST* furnish the editor of this department with a few separate impressions of the Anthropological Notes, and he will cheerfully supply copies to contributors of short sketches if they will send their address.

GEOLOGY AND PALÆONTOLOGY.

GLACIAL PHENOMENA IN BRITISH COLUMBIA.—In a recent pamphlet, entitled "On the Superficial Geology of British Columbia," Mr. G. M. Dawson draws fresh attention to the moraines, glacial grooves and ice marks in north-western America. His conclusions which we append are of a good deal of interest in connection with the former statements made as to the lack of glacial deposits in Alaska and neighboring regions southward.

1. The character of the rock striation and fluting on the south-eastern peninsula of Vancouver island shows that at one time a great glacier swept over it from north to south. The glacier must have filled the Strait of Georgia, with a breadth, in some places, of over fifty miles, and a thickness of ice near Victoria of considerably over six hundred feet. Traces of the glaciers are also found on San Juan island, and the coast of the mainland.

2. The deposits immediately overlying the glaciated rocks, besides hard material locally developed, and probably representing *moraine profonde*, consist of sandy clays and sands, which have been arranged in water, and in some places contain marine shells. These, or at least their lower beds, were probably formed at the foot of the glacier when retreating, the sea standing considerably higher than at present.

3. Observations in the northern part of the Strait of Georgia, and the fjords opening into it—where the sources of the great glacier must have been, show ice-action to a height of over 3000 feet on the mountain sides. The fjords north of the Strait of Georgia show similar traces. Terraces along the coast of the mainland are very seldom seen, and have never been observed at great elevations.

4. In the interior plateau of British Columbia there is a system of glaciation from north to south, of which traces have been observed at several localities above 3000 feet. Subsequent glaciation, radiant from the mountain-ranges, is also found.

5. The superficial deposits of the interior may be classified as unmodified and modified. The former, representing the Boulder-clay, hold many water-rounded stones, with some glacier-marked, and occurs at all heights up to over 5000 feet. The latter characterize nearly all localities below 3000 feet, and are most extensively developed in the northern low country, where they appear as a fine white silt or loess.

6. The interior is marked with shore-lines and terraces from the

present sea-level up to 5270 feet, at which height a well-marked beach of rolled stones occurs on It-ga-chuz mountain.

7. Moraines occur in great numbers. Some of the moraine-like accumulations may have been formed in connection with the north-to-south glaciation. Most of those now seen, however, mark stages in the retreat of glaciers towards the various mountain ranges. The material of the moraines resembles that of the Boulder-clay, but with water-rounded stones even more abundant.

8. The sequence of events in the interior region has been: glaciation from north to south, with deposit of Boulder-clay, formations of terraces by lowering of water-surface, accompanied or followed by a warm period; short advance of glaciers from the mountains contemporaneously with the formation of lower terraces; retreat of glaciers to their present limits. Glaciation of Vancouver island may have occurred during both the first and second cold periods, or during the second only.

9. If the north to south glaciation has been produced by glacier ice, it must have been either (*a*) by the action of a great northern ice-cap (against which grave difficulties appear), or (*b*) by the accumulation of ice on the country itself, especially on the mountains to the north. In either case it is probable that the glacier filled the central plateau and, besides passing southward, passed seaward through the gaps and fjords of the coast range. The Boulder-clay must have been formed along the front of the glacier during its withdrawal, in water, either that of the sea, or of a great lake produced by the blocking by local glaciers of the whole of the valleys leading from the plateau, to a depth of over 5000 feet.

10. If general submergence to over 5000 feet be admitted, the Japan current would flow strongly through Behring's Strait, and over part of Alaska, while Arctic ice-laden water, passing south across the region of the Great Plains, would also enter the central plateau of British Columbia, accounting for the north to south glaciation and simultaneous formation of the Boulder-clay.

THE SPECIES OF RHINOCEROS OF THE LOUP FORK EPOCH.—Prof. Cope recently exhibited to the American Philosophical Society the crania of three species of rhinoceros which he had obtained from the Loup Fork beds of Kansas and Colorado. Two of them which were new to science, he named *Aphelops fossiger* and *A. malacorhinus*. Of the third species, the *A. megalodus* (Cope), two crania were exhibited, one of them in a remarkable state of preservation. Three crania of the *A. fossiger* and one of the *A. malacorhinus* furnished their distinctive characters. The *A. megalodus* is the smallest species, and about as large as the smaller race of the *Rhinoceros sondaicus* according to Cuvier. It has a narrow elevated occiput, long and smooth nasal bones, a contracted preorbital region, and one large infraorbital foramen. The *A. malacorhinus* is a very peculiar species. It has very short

and small nasal bones, a broad front and a narrow and high occiput. The preorbital region is concave, and there are three infraorbital foramina. It is as large as the existing *Atelodus bicornis*. In the *A. fossiger* the occipital region does not rise above the level of the front, and is laterally expanded. The preorbital region is wide and convex, and there is one large infraorbital foramen. The size is about that of the *A. malacorhinus*, but the molar teeth are larger than those of the *Rhinoceros indicus*. They are peculiar in the great vertical depth of their fossæ, and the isolation of the posterior notch as a pit. This species was quite abundant during the period of the Loup Fork epoch, and were contemporaries of the *Mastodon campester* and several species of horses.

HIGH AND LOW WATER IN THE ST. LAWRENCE RIVER.—Unlike most rivers the St. Lawrence is not subject to sudden or very noticeable fluctuations in respect to the depth of its waters. It is stated, however, by residents in the vicinity that once in about seven years the water rises two or three feet above its ordinary level. There is no question but that this is the case in certain years, although it may be doubted whether the period of unusual rise commonly given is according to the fact. Two years ago, in the summer of 1876, the extraordinary height of the water in Lake Ontario and in the river above the rapids was a subject of common remark. The rise and subsidence are both gradual, continuing several months in the year mentioned, lasting throughout the entire summer and autumn. I am not informed in regard to the existence of any special records of observations made to determine the cause of this somewhat striking phenomenon. If it is due to an unusual fall of snow the preceding winter, causing an increase of water throughout the immense territory drained by this river, the fact can be determined directly from the Weather Reports furnished by the Signal Service Bureau.—*M. A. Veeder, Antwerp, N. Y.*

THE PALÆONTOLOGY OF VICTORIA.—As palæontologist to the Geological Survey of Victoria, Prof. McCoy has lately issued the fifth decade of the survey publications. This is a series of ten plates, with text, illustrating some of the more interesting fossils which have lately come under the notice of the surveyors. One of the more noteworthy of the fossils here described and figured is a curious object resembling the calcareous axis of a large sea-pen living in Hobson's Bay, but considerably larger. It is believed that it can claim a place in the European Tertiary genus *Graphularia*, and is accordingly described as *G. robinæ*. In shape the fossil is conical below and quadrate above, while internally it exhibits on fracture a radiating crystalline structure. Its interest lies in its curious resemblance to a belemnite. Some time ago it was announced that a belemnite had been discovered

in Tertiary rocks in Australia, an announcement which of course created much surprise, since it had previously been an article of geological faith that belemnites were exclusively mesozoic fossils. Prof. McCoy now suggests that the fossil taken for a belemnite may have been the new *Graphularia* which he describes in the present decade, or some other very similar fossil. Another notable Victorian fossil noticed here for the first time is an eared seal of Pleistocene age, to which the name of *Arctocephalus williamsi* is given.—*Academy*.

GEOGRAPHY AND TRAVELS.

GEOGRAPHICAL NOTES.—The *Geographical Magazine* contains a map showing the Himalayan explorations of Mullah, one of the explorers of the Great Trigonometrical Survey of India.—Dr. Kirchhoff, President of the Halle Geographical Society, has discovered, in the library of the University, a copy (apparently) of part of the original log book of Captain Cook, during his voyage in 1772. The book was bequeathed to the library referred to by John Reinhold Foster, Cook's companion, who died in Halle.—Lieut. Wyse at last accounts was exploring the Isthmus of San Blas, the narrowest point between the Atlantic and Pacific oceans.—M. Deloncle of Lyons, concludes from documents in his hands, that (1) Lake Tanganyika was not known to be in existence at the time of the missionary journeys of the 14th, 15th and 16th centuries; (2) that Mayamuezi, Ugogo, Uganda and other districts were known in the fourteenth century; (3) that Lakes Victoria and Albert Nyanza, Banguelo and Moero had been explored at the same time; (4) that the wide northern affluent of the Lualaba, discovered by Mr. Stanley, issues from the Albert Nyanza; (5) that Lake Nyanza was a basin, much larger than now.—Dr. Traummüller of Leipzig, who resided at Batavia between 1867-1870, in the course of many excursions in the interior of Java, visited the volcanoes Gede and Panggerango, and the famous "Valley of Death." The carbonic acid gas which here accumulates to a height of two or three feet above the ground is noxious to small animals, but harmless to human beings. A former connection between Asia and Java appeared to the author to have once indubitably existed.—On the 6th of May, a little schooner, the *Willem Barrents*, an eight ton craft, sailed from Amsterdam for a six months' cruise in the Arctic regions. The whole ship's company consists of fourteen—six scientific experts and eight sailors and officers. The enterprise is strictly national, foreign aid having been refused, and nothing even having been asked of the Dutch Government, but everything being supplied by voluntary contributions. The schooner will pursue the track of previous Dutch navigators, along the north-west coast of Spitzbergen, to Nova Zembla, and thence as far to the north-west as can be reached in season for the schooner to return before next winter.—The *Times* says the

Jeannette (Pandora) will be ready for sea in a short time, and then sail for Havre, where a temporary crew will be shipped, when she will leave for San Francisco. Mr. Bennett hopes the expedition will sail for the North in June, 1879. It will go by the route through Behring's Straits.—Prof. Nordenskiöld's expedition for the north-east passage sails in the *Vega*, in July.—The vessel *Eothen*, with twenty-five men, will sail from New York in July for the Arctic regions in search for the relics of Sir John Franklin.

MICROSCOPY.¹

DETERMINATION OF ROCKS BY THE MICROSCOPE.—At the regular meeting of the San Francisco Microscopical Society, May 16th, Mr. Melville Atwood presented twenty-two rock specimens illustrating a new method of preparing the same for determination, and read a very interesting paper on the subject. He is aware that looseness in petrological nomenclature is the rule and not the exception, and that many geologists are found writing of totally different rocks under the same name. But he is still more impressed with the ignorance of the miners in regard to the rocks which form the boundaries of the different mines. He does not value much any distinction between rocks which cannot be applied in the field, and he found, while making a collection of rock specimens prepared in different ways, that what was most wanted was a method to make it easy for his fellow-miners to understand and distinguish the enclosing and wall rocks of the different lodes they were working—these rocks having so much to do with the productiveness of the lodes. To prepare rocks so that they can be easily studied with a pocket lens or a low power of the microscope and accurately identified by comparison with a collection of foreign types, they are prepared as follows: "First wash the specimen clean, using a brush to get rid of any clay and dirt; then select the side or part you wish to examine, and grind it down on a piece of sandstone (a shoemaker's sharpening stone) until a perfectly flat surface is obtained. This will occupy but a few minutes unless the rock is very hard. The surface should then be worked down still finer with a square emery file, using water, and after you have obtained a sufficient polish, wash the rock again and then let it dry gradually, either on a stove or, what is better still, a little brass table with a spirit lamp, the same that is used for heating slides. When perfectly dry heat it again to a point so that you can barely handle it; then varnish the polished side while hot with a mixture of one part of Canada balsam to three parts of alcohol, which must be warmed before applying it, and laid on with a camel's hair brush. It will soon dry, and if left for a day or two will harden, so that you can handle it without injury." This simple and rough treatment is

¹ This department is edited by Dr. R. H. WARD, Troy, N. Y.

described as remarkably successful in making plain the characteristics of the rocks.

OLEOMARGARINE.—Mr. John Michels has recently studied this substance, and drawn its appearance under the microscope. The abundant fat globules and occasional crystals of common salt which are found in real butter are almost entirely wanting, and in their place are found an abundance of large feathery crystals and of fragments of animal tissues. As the fat is merely liquified and set free by a heat not exceeding 120° Fahrenheit, and manipulated so as to have the general appearance of butter, any germs of disease or embryos of parasites it may have contained are liable to be preserved alive and transferred to the systems of those who make use of the substance. He therefore considers the oleomargarine, though for cooking purposes an excellent substitute for any fat previously used, to be eaten in a raw state as a substitute for table butter only at considerable risk.

Mr. E. J. Wickson described at the San Francisco Society the character of oleomargarine cheese. The cream from the milk is removed, and then liquid oleomargarine stirred in to replace the fat thus taken away. The mass is agitated, and rennet enough added to form a curd quickly before the oil can separate from the skim milk, in order to form an emulsion of oil and a menstruum of solid casein, like that which exists in cheese from natural milk. This process has succeeded so well that chemical analysis has shown the artificial cheese richer than the genuine, and so great an improvement on skimmed cheese that large quantities are sold in New York and shipped to Europe. Under the microscope this artificial preparation, on account of the imperfect emulsion formed, shows cavities of irregular shape in which the artificially introduced fat was imprisoned when the curd was formed, instead of the smooth mixture of fat globules found in cheese from full cream milk.

A RARE SALE.—The microscopes, objectives, accessories and objects of the late distinguished and critical microscopist, John E. Gavit, are now offered for sale by his son, W. E. Gavit, of Stockbridge, Mass., from whom catalogues and particulars can be obtained.

EXCHANGES.—The San Francisco Microscopical Society is now enabled, by the kindness of the State Geological Society, to offer return exchanges of Pacific Coast diatomaceous deposits on receipt of any valuable microscopical material.

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SCIENTIFIC NEWS.

— Professor Joseph Henry, of the Smithsonian Institution, died May 13th, at Washington, of Bright's disease of the kidneys. Professor Henry was born in Albany, N. Y., on the 17th of December, 1797. At the end of a course of study at the common

schools he entered the Albany Academy, where he displayed a marked taste for scientific and mechanical branches, and he followed a natural bent when he afterward learned the watchmaker's trade. In 1826 he laid aside his business to become an instructor at the Academy, and the next year began a series of experiments in electricity which introduced him to the notice of the world of scholars. Among his earliest discoveries was the fact that in the transmission of electricity for great distances, the power of the battery must be proportioned to the length of the conductor, and he was the first to magnetize a piece of iron at a distance or make use of electro-magnetism as a motor for machinery. In the last instance an oscillating iron beam was surrounded by a conductor or insulated copper wire. A current of electricity was sent through this in one direction, which caused one end to be repelled upward and the other attracted downward by two stationary magnets. The downward motion of the one end of the beam near its lowest point brought the conducting wires in contact with the opposite poles of the battery, which produced the reverse motion, and so on continually. In a later arrangement the velocity of motion was regulated by a fly-wheel, and electro-magnets substituted for the permanent magnets at first used.

In 1829 Prof. Henry prepared some electro-magnets of a power higher than any yet produced, and one which he afterwards constructed on the same plan, and which will sustain thirty-six hundred pounds with a battery occupying only a cubic foot of space, is still exhibited in the cabinet of the College of New Jersey. Continuing his investigations, he at length astounded his friends by applying the principle which we now see in use every day in the electric telegraph—making a bell to ring at one end of a wire a mile long by the transmission of a current from the other end; and in a paper printed in Silliman's *American Journal of Science* in 1831, he pointed out the possibility of employing such an agency for the instantaneous conveyance of intelligence from one point to another far distant. This, it must be remembered, was thirteen years before Morse put the idea into practical operation. Within a twelve-month of the time these startling experiments were published, Prof. Henry was called to the Chair of Natural Philosophy in Princeton College. In 1837 he visited London, where he interested Sir Charles Wheatstone, then a Professor in King's College, in his discoveries, elaborating some of them and suggesting the capabilities opened up by others. When the Smithsonian Institution was organized at Washington, Professor Henry was appointed its Secretary, and he has filled that responsible position ever since with distinguished ability. His research has been confined to no one department of science, and his zeal for the dissemination of results has kept pace with his devotion to the improvement of process. In 1872 we find him negotiating with the authorities of the Atlantic cable to procure the free transmission

of important discoveries in astronomy, till he has perfected a system by which an announcement is flashed from any part of America to the Smithsonian Institution, and thence to the observatories in Paris, London, Berlin and Vienna, all in a time scarcely long enough to estimate and without drawing a dollar from the proverbially low purses of the star-gazing fraternity. The same year witnessed the completion by the Royal Society of London of a "Catalogue of Scientific Papers"—a compilation of incalculable usefulness to scholars—mainly in response to a suggestion made by Professor Henry in 1858. To him we owe, perhaps, more than to any one man, our present position as a nation in the domain of meteorology; it was he who devised our system of weather despatches, and who foresaw the importance of tabulating them and preparing the daily maps now in use. As an astronomer he was a leading figure as early as 1845, when he published his observations on the temperature of the sun, which were confirmed by Secchi seven years later, and have remained unshaken in their passage through a score of hands since. As a topographer he took a lively interest in the changes of level in the neighborhood of the Great Salt Lake, and it is at his suggestion that a monument was erected there, in 1874, for the purpose of making standard measurements. It was he who, at the age of seventy-seven, successfully entered the lists with Professor Tyndall as an investigator of the questions involved in the perfection of fog signals for use on the ocean coasts. Thus in every domain he enters we find him an enthusiast and a master, his whole soul given to the advancement of the good of his race by practical means.

His place will be difficult to fill in many ways, but his loss will be especially felt on account of the influence of his noble moral character. He was a man of the clearest sense of justice, and would tolerate no wrong; yet as a good man he was not prone to suspect evil in others. His rectitude was equalled by his charity; but this virtue did not, as too frequently, impair the decision of his acts. He was essentially free from partisan spirit, and although his own views were broadly liberal, he had no sympathy with the methods of some of the modern apostles of liberalism, who while they destroy, fail to offer satisfactory substitutes. The young scientists of this country of the present generation, who have so often found him a friend in the past, are fortunate in the possession of his example for the future.

—The distinguished invertebrate palaeontologist, Wm. M. Gabb, died May 30th, in this city, of consumption. He was born January 20, 1839, and was consequently in his fortieth year. He had returned home but a short time previous to his death from Santo Domingo, where he had so ably labored in his chosen pursuits—geology and palaeontology. He began his career as geologist in the capacity of chief of the Geological Survey of Califor-

nia, to which post he had been assigned by Prof. Whitney. He made extensive geological and geographical explorations along the west coast, California, Oregon and Nevada; he also engaged in a survey of the peninsula of Lower California, of which it is said he made the most accurate map extant. His principal work, however, was his explorations in Costa Rica, and especially Santo Domingo, to the topography and geology of which he had given much study, and the results of which he embodied in his quarto report published by the American Philosophical Society. Numerous other papers on the secondary fossils of the United States, Santo Domingo and Peru were contributed by him to the Proceedings and Journal of the Academy of Natural Sciences and to the Transactions and Proceedings of the American Philosophical Society. American science sustains a severe loss in his death in the departments in which he labored, and to which he had contributed upwards of fifty papers up to the time of his death.

— The North Mountain Camp of Physical Culture, so successfully established by Dr. J. T. Rothrock in 1876, and continued last summer by Messrs. Taylor and Frank, will be open during the coming months of July and August, and will be conducted upon the same general plan as that of previous years.

The primary object of the Camp-School is *physical culture*. No stated lessons from books will be required, nor will close mental application be allowed, though a part of each day will be devoted to instruction, which will consist of lessons in Geology, Botany, General Natural History and Drawing from Nature.

The location of the camp is near a mountain lake in the southeastern part of Sullivan Co., Pa., at an altitude of over two thousand feet above tide.

As a rule, boys from twelve to seventeen years of age only will be admitted, though in exceptional cases it may be found proper to admit others.

For the term of two months the charge is \$100. This includes boarding, washing and tuition. While it is desirable that pupils remain during the entire term, they will be received for any part of the term, and will be charged in proportion to the time spent in camp. In all cases, however, one-half of the sum must be paid on entering, and the remainder when the pupil begins the latter half of his term, of whatever length it is decided that shall be.

The better route to reach the camp is by the Lackawanna and Bloomsburg Railroad to Shickshinny, and thence by stage to the North Mountain House.

For further information address L. H. Taylor, University of Pennsylvania, Box 2838, Philadelphia, prior to July 1, 1878; after that, Shickshinny, Luzerne Co., Penna.

— The Bridgeport Scientific Society was organized last year with H. N. Powers, D.D., president, and Clarence Sterling, cura-

tor, and has issued a circular calling attention to the desire on the part of the society of establishing a museum to illustrate the natural history and archæology of Western Connecticut. Correspondents and donors should address Clarence Sterling, curator Scientific Society, Bridgeport, Conn.

— The Cincinnati Society of Natural History has issued the first number of its journal, the subscription price of which is \$2.

— The Chesapeake Zoölogical Laboratory of Johns Hopkins University opened June 15th for a two month's session at old Point Comfort, Va., under the direction of Dr. W. K. Brooks.

— Mr. J. W. Groves, of the South London Microscopical Club, after cleaning glass slides for mounting microscopical objects, by one of the usual processes, fastens them together by their edges, after the manner of the well-known artist's sketching blocks. This is easily done with a pile of slips, by fixing around their edges a piece of ready gummed tissue-paper, ten inches long, and of a width suitable to the number of slides, so that, although they are firmly bound together, their surfaces are left uncovered. The block is left to dry, when each slip may be detached by running the thumb nail round its edges. The surface next the adjoining slip should be used for the preparation to be mounted on, as it is, of course, quite clean, although the exposed one may have become dirty; the fragments of tissue-paper are removed after the mount is completed.—*Quarterly Journal of Science, London.*

— Under the title of *Essai sur le Classement des Animaux qui vivent sur la Plage et dans les Environs de Dunkerque*, M. O. Terquem gives a catalogue, illustrated with five excellent plates, of the Foraminifera which live on the shores of Dunkirk, Belgium.

— The total production of silk-cocoons in Europe amounted upon an average to 58,000 tons per year during the last five years. Italy stands first in the list of silk-producing countries, producing 39,000 tons per year; France produces about 10,000 tons; Turkey 4000; Spain 2200; Austria 1900; Portugal 250; Greece 200; Russia 150; Germany 100, and Belgium and Switzerland only 100 tons together.—*Nature.*

— Arrivals at the Philadelphia Zoölogical Garden: 1 spotted sandpiper (*Tringoides macularius*); 1 zebu (*Bos indicus*) ♂, born in the garden; 2 lizards (*Holbrookia maculata* and *Crotaphytus collaris*), Texas; 2 Carolina parrakeets (*Conurus carolinensis*); 1 corn snake (*Coluber guttatus*); 1 mountain black snake (*Coluber obsoletus*); 1 blue-jay (*Cyanurus cristatus*); 1 ring-necked snake (*Diadophis punctatus*); 9 prairie dogs (*Cynomys ludovicianus*), born in the garden; 1 broad-winged buzzard (*Buteo pennsylvanicus*); 1 spreading adder (*Heterodon platyrhinus*); 1 pine snake (*Pityophis melanoleucus*); 1 glass snake (*Ophiosaurus ventralis*); 1 opossum and young (*Didelphys virginiana*); 1 scarlet ibis (*Ibis rubra*), South America; 2 copperheads (*Ancistrodon contortrix*); 1 great horned

owl (*Bubo virginianus*); 2 gray foxes (*Vulpes virginianus*); 1 raccoon (*Procyon lotor*); 1 garter snake (*Eutania sirtalis*); 1 woodchuck (*Arctomys monax*); 5 alligators (*Alligator mississippiensis*); 2 wild boars (*Sus scrofa*), North Africa.

— A new industry has recently sprung up in parts of Minnesota, namely, frog culture; it is a simple matter, consisting chiefly in the protection of eggs and tadpoles from birds and other enemies, by means of wire screens. The product, thus far reported, amounts to 3,000 dozen of frogs' legs, of which about two-thirds have been shipped to St. Louis. The average quotation of prices is 20 cents per dozen.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

AMERICAN GEOGRAPHICAL SOCIETY.—May 14.—Mr. Jesse Young read a paper upon his recent journey of exploration as the astronomer of the Giles Expedition across the continent of Australia, with descriptions of the deserts, native races and the natural history of the country.

May 28.—Gen. C. Chaillé Long lectured on Egypt, Africa and Africans, embracing the following subjects: Egypt's annexations; the results of his expeditions in Central and Oriental Africa; his discovery of Lake Ibrahim and two hundred miles of the unknown White Nile; the source of the Nile; M'tse, King of Uganda; the Niam-Niams; Akka, or Ticki-Ticki, and the Anthropophagi and pigmy tribes.

BOSTON SOCIETY OF NATURAL HISTORY.—May 15.—Mr. Richard Rathbun read a Description of a Coral Reef in the Bay of Bahia, Brazil. Mr. J. A. Allen spoke on the Fossil Birds of North America, and Dr. T. Sterry Hunt remarked on the Taconic Rocks of North America.

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SCIENTIFIC SERIALS.¹

TRANSACTIONS OF THE AMERICAN ENTOMOLOGICAL SOCIETY.—The last numbers (1 and 2 of vol. vii.) of the Transactions of the American Entomological Society, contains some articles of unusual interest. Among them are Notes on some species of *Hister*, and an elaborate revision of the species of *Aemecodera* of the United States, by Dr. Horn, illustrated by a plate. Dr. Horn also contributes Notes on some genera of *Cerambycidae* of the United States. A number of new North American *Hymenoptera* are described by Mr. E. T. Cresson, comprising mostly bees. The most important paper is Dr. Horn's Descriptions of the larvæ of the North American genera of *Cicindelidae*, also of *Dicelus*, with a note on *Rhynchophorus*, and illustrated with a plate, showing with more or less detail the larvæ of *Amblychila cylindriciformis*, *Onus dejeanii*, *Tetracha carolina*, *Cicindela repanda*, *Dicelus (costatus?) purpuratus?*

¹ The contents of these journals are for the most part selected.

THE GEOGRAPHICAL MAGAZINE.—May. Prejevalsky's Explorations in Central Asia (with a map showing his route from Kuldja across the Tian-Shan to Lob-Nor and the Altyn-Tag, 1876-77). Himalaya explorations (with a map of the Mullah's new explorations in the Chitral Valley, and along the course of the Indus). The Cossacks, by C. A. G. Bridge. Salang Island, by A. de Richelieu. Droughts and climates at the Cape of Good Hope, by W. J. Black.

THE GEOLOGICAL MAGAZINE.—May. Geological Time, Part II., by C. L. Morgan. Erratics at high levels in North-western America—barriers to a great ice-sheet, by G. M. Dawson. Denudation—rain and river, by H. O. Forbes. The fossil-fish localities of the Lebanon, by G. R. Lewis. Occurrence of a fresh water sponge in the Purbeck limestone.

SIEBOLD AND KÖLLIKER'S ZEITSCHRIFT.—April 23. Form of the crystalline cone in the eyes of arthropoda, by O. Schmidt. On Anomia, with remarks on the comparative anatomy of the muscles in Lamellibranch Molluscs, by H. V. Ihering. The poison apparatus and anal glands (secreting an odorous fluid) in ants, by A. Forel. Separation of the order of Oscines from the Clamatores, Scansores and Columbidae by the structure of the egg-shell, by W. von Nathusius. Contribution to a knowledge of the postembryonal formation of the limbs in insects, by H. Dewitz. On the ornamental colors of Daphnidae, by A. Weismann.

May 7.—On the structure of sponges (Reniera), by E. Keller. Contributions to a knowledge of the urinary vessels of insects, by E. Schindler.

Supplement to May 7.—On the Amphipods and Isopods (structure of the antennae, gills, &c.), by F. Leydig. On the development of the testes and on alternation of generations in Salpae, by W. Salensky. On the method of Zoölogy, by P. Kramer. On the reproductive organs of some ectoparasitical marine Trematodes, by C. Vogt. The movements of flying fish through the air, by K. Moebius. Faunistic studies in the fresh water lakes of Switzerland, by F. A. Forel.

CANADIAN ENTOMOLOGIST.—April. Notes on *Grapta comma* and *interrogationis* (relates to dimorphism) by W. H. Edwards.

CANADIAN NATURALIST.—April 10. Notes on some Scottish Devonian Plants, by J. W. Dawson. Traveling notes on the Surface Geology of the Pacific Slope, by G. M. Dawson. On some Jurassic fossils from the Coast range of British Columbia, by J. F. Whiteaves. Notes on the Locust in the North-west, in 1876, by G. M. Dawson. The mechanical effects of Arctic ice in producing ocean currents, by H. Y. Hind.

